VOL. 5 NO. 18
September 30, 1980

Energy Research Abstracts

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Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications are regularly issued which are comprehensive in their coverage of certain energy fields. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

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Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

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ENERGY RESEARCH ABSTRACTS

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About *Energy Research Abstracts*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

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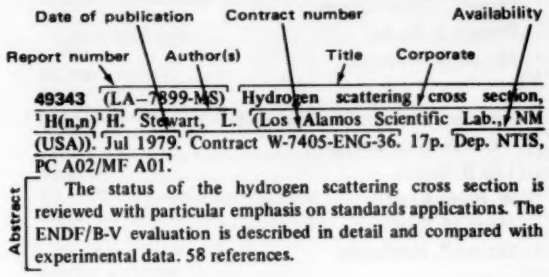
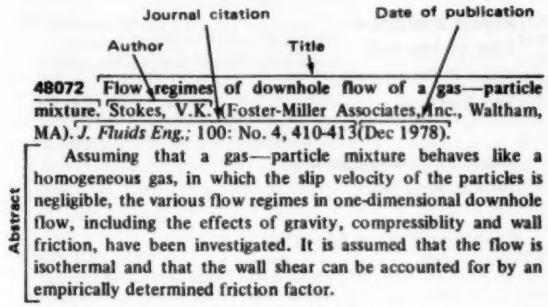

Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

• INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. **(Los Alamos Scientific Lab., NM (USA))**. Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

• Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
LA-tr-78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 29164

28262 (ORNL/TM—7375) **Fossil Energy Program. Progress report for April 1980.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 112p. NTIS, PC A06/MF A01.

This report - the sixty-ninth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, chemical research and development, materials technology, component and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, coal preparation and waste utilization, coal preparation plant automation, atmospheric fluidized bed coal combustor for cogeneration, technical support to the TVA fluidized bed combustion demonstration plant program, coal cogeneration/district heating plant assessment, performance assurance system support, and international energy technology assessment.

PROCESSING

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 28270, 28276, 28312, 28313, 28314, 28335

HYDROGENATION

REFER ALSO TO CITATION(S) 28315

28263 (FE—2305-33) **Investigation of mechanisms of hydrogen transfer in coal hydrogenation. Quarterly progress report, January-March 1979.** Cronauer, D.C.; Ruberto, R.G.; Young, D.C. (Gulf Research and Development Co., Pittsburgh, PA (USA)). May 1979. Contract AC01-76ET10575. 20p. NTIS, PC A02/MF A01.

Several unusual characteristics have been observed in the treatment and analysis of asphaltenes derived from low severity liquefaction runs. Specifically, some of the asphaltene samples are not miscible with with n-pentane, but they are still of sufficiently low viscosity to flow through a Soxhlet thimble and plug up the apparatus. Comments on the approach to preparation and analysis of the asphaltenes are sufficiently complex that anyone interested should read the text. Chemical characterization of selected asphaltene samples is being done. In this regard, the analysis of the oxygen functional groups in the Illinois coal asphaltenes indicate that most of the oxygen is present as hydroxyl groups. The levels of carboxylic and carbonylic oxygens are essentially zero. It is assumed, therefore, that the remaining oxygen is etheric. (LTN)

28264 (FE—2702-10) **Kinetics and mechanisms of catalytic hydroliquefactio and hydrogasification of lignite. Quarterly report, January-March 1980.** Weiss, A.H.; Kranich, W.L.; Gueruez, K. (Worcester Polytechnic Inst., MA (USA)). 20 Apr 1980. Contract AS01-77ET10618. 29p. NTIS, PC A03/MF A01.

Unexpected continued delay in the delivery of a new pump has prevented expansion of the range of flow rates already studied on lignite liquefaction in the continuous stirred tank reactor. Data previously reported have been refined and for the most part confirmeed. Agitator speed does not affect reaction rate over the range of speeds used in experimental runs, but hydrogen pressure appears to exert an influence particularly at higher temperatures. A new batch reactor has been put into operation which is expected to yield valuable catalyst screening and kinetic data. Successful design, fabrication and operation of a fast-feed mechanism should greatly reduce the long preheating times which obscure the kinetic results of most batch studies.

28265 **Carbon-carbon cleavage during Birch-Hueckel-type reductions.** Collins, C.J.; Hombach, H.P.; Maxwell, B.; Woody, M.C.; Benjamin, B.M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Am. Chem. Soc.;* **102**: No. 2, 851-853(16 Jan 1980).

Results of reactions of Na-K alloy in the solvent system glyme-triglyme on a series of compounds, bibenzyl, 1,2-diphenylpropane, diphenylmethane, and phenyl-p-tolylmethane, to determine whether the Birch-Hueckel reduction could be used in this solvent system to cleave C-C bonds are reported. Both methyl-^{14}C iodide and water were studied as quenchers, and the products from all reactions were analyzed by gas chromatography. The results indicated that coal can be efficiently degraded at low-temperatures by cleavage of aliphatic as well as aromatic-aliphatic C-C bonds by the action of Na-K alloy under conditions studied in this work. (BLM)

GASIFICATION

REFER ALSO TO CITATION(S) 28324, 28326, 28330, 28336, 28340, 28368, 28372, 28565, 28571, 28913, 28914, 29294, 29342, 29370, 29385

28266 (BMFT-FB-T—80-030) **Report on the engineering of the pilot plant for hydrogasification of coal in framework of the PNP-project. Final report.** Ruddeck, W.; Langer, H. (Rheinische Braunkohlenwerke A.G., Koeln (Germany, F.R.). Abt. Forschung und Entwicklung). Jun 1980. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01.

Coal gasification processes have been known and well-tested for a long time. A number of further developments are being worked out; the main targets are to increase the gasification pressure and to save feed coal. Saving of feed coal is guaranteed in an optimum way by the processes which are developed within the framework of the project Prototype Plant Nuclear Process Heat (PNP). The use of nuclear process heat makes it possible to save up to 40% of the coal needed in conventional processes. Further advantages involved in this process are the increase in efficiency, reduction in emissions specific to coal and expected improvements of economy. One of these processes is the hydrogasification of coal (in a fluidized bed) which represents a key technology for producing synthetic natural gas (SNG). Hydrogasification of coal can be operated on either a conventional or nuclear basis. The first steps in developing this process were planning, construction, and operation of a semitechnical test plant with a design capacity of 100 kilograms C/h. So far, more than 700 metric tons of dry lignite and hard coal have been gasified in this test plant during an operation period of more than 4500 h. The promising results formed the basis for planning a pilot plant which is the last step before the implementation on a large technical scale. Basic engineering for this pilot plant was completed in mid-78 and was described in the research report ET 1023 A. This report deals with the work continued on detailed engineering for the period from mid to late 1978. The pilot plant is scheduled to be completed in late 1981.

28267 (BMI—2059) **Correlation of the high-temperature corrosion behavior of structural alloys in coal conversion environments with the components of the alloys and of the corrosive environments. Final report, February 29, 1980.** Wright, I.G.; Dodds, R.O.; Palmer, R.B.;

Link, H.A.; Merz, W.E.; Beatty, G.H. (Battelle Columbus Labs., OH (USA)). 29 Feb 1980. Contract AT02-76CH92092. 141p. NTIS, PC A07/MF A01.

This program was established at Battelle's Columbus Laboratories to provide information on the effects of a wide range of simulated coal gasifier atmospheres on the high-temperature corrosion behavior of a small number of alloys, to supplement existing alloy screening programs in this area. Four alloys: Inconel 671; AISI 310; Incoloy 800 and USS 18-18-2, were exposed in a series of statistically-designed experiments for times up to 1000 h in simulated coal gasifier atmospheres at total pressures of 500, 1000 and 1500 psig, and at temperatures of 1382, 1600 and 1800°F. Some data were also generated for alloys GE 1541 and Sandvik 253 MA. The progress of corrosion was evaluated by standardized metallographic techniques, with effects on mechanical properties assessed by post-test tensile tests. The data generated were statistically analyzed to determine trends. The results indicated that increasing temperature exerted a significant effect by increasing the extent of corrosion of Inconel 671, Incoloy 800 and USS 18-18-2, whereas increasing total pressure caused a significant decrease in the extent of corrosion of Incoloy 800 and AISI 310. Temperature was the most important variable affecting the tensile strength of the corroded specimens; the ultimate tensile strength of Inconel 671, AISI 310 and USS 18-18-2 increased (relative to aged specimens) with increasing temperature, suggesting that some corrosion morphologies may not be significantly detrimental. Decreasing total pressure from 1500 to 500 psig exerted a significant effect on the UTS of USS 18-18-2 only, causing a decrease.

28268 (CONF-800602—7) **On-line sampling and analysis at the University of Minnesota-Duluth coal gasifier.** Million, D.L.; Klein, J.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From Symposium on instrumentation and control for fossil energy processes; Virginia Beach, VA, USA (9 Jun 1980).

The Life Sciences Synthetic Fuels Program at Oak Ridge National Laboratory was commissioned by the US Department of Energy to implement an extensive environmental monitoring and sampling program at the new University Minnesota-Duluth coal gasifier, part of the DOE gasifiers in Industry program. One aspect of the monitoring program involved setting up an on-line sampling and analysis system in the gasifier plant in order to provide supporting data to the more extensive laboratory analyses of process samples. To date, a minicomputer system has been installed and programmed to continuously collect analog temperature, flow, and pressure data from plant instruments. A process gas chromatograph system, an SO_2/NO/sub x/ analyzer, and continuous CO monitors are also being used to collect process and work environment samples, and to record results on the computer. The computer software has been designed to ensure automatic data logging with a minimum of operator supervision, as well as providing data summary, data storage, and plotting routines. The collected data are used not only to support the overall ORNL monitoring program, but also to supply important process information to the gasifier plant operators.

28269 (DOE/FE—0004/79/2) **Coal demonstration plants. Quarterly report, April-June 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Apr 1980. 75p. NTIS, PC A04/MF A01.

The objective of the US DOE demonstration program is to demonstrate and verify second-generation technologies and validate the economic, environmental and productive capacity of a near commercial-size plant by integrating and operating a modular unit using commercial size equipment. These facilities are the final stage in the RD and D process aimed at accelerating and reducing the risks of industrial process implementation. Under the DOE program, contracts for the design, construction, and operation of the demonstration plants are awarded through competitive procedures and are cost shared with the industrial partner. The conceptual design phase is funded by the government, with the detailed design, procurement, construction, and operation phases being co-funded between industry and the government. The government share of the cost involved for a demonstration plant depends on the plant size, location, and the desirability and risk of the process to be demonstrated. The various plants and programs are discussed: Description and status, funding, history, flowsheet and progress during the current quarter. (LTN)

28270 (DOE/METC/8085—3) **42-inch diameter producer stream gas clean-up system mathematical model.** (TRW Energy Systems Management Div., Redondo Beach, CA (USA)). Mar 1979. Contract EY-77-C-21-8085. 136p. NTIS, PC A07/MF A01.

The purpose of this work is to develop a computer simulation program that will expedite the development and aid in the optimization and scale-up of the Morgantown Energy Technology Center (METC) low-Btu coal gasifier system. The gasifier system includes the METC low-Btu fixed-bed gasifier and the producer gas clean-up system. The producer Gas Clean-Up System Simulation Program, the subject of this report, develops the mathematical models and computational procedures for the material balance calculation around each of the seven major process units that constitute the METC producer gas clean-up system: gas cyclone, humidifier, electrostatic precipitator, hydrolysis unit, direct cooler, Stretford process, and final wash tower.

28271 (DOE/METC/8085—4) **Morgantown low-Btu gasifier simulation program.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center; TRW Systems and Energy Group, Morgantown, WV (USA)). Oct 1978. Contract EY-77-C-21-8085. 104p. NTIS, PC A06/MF A01.

This project's overall purpose is to develop a Morgantown low-Btu gasifier system simulation program. The gasifier system consists of a moving bed gasifier and a gas clean-up system, and the present report concerns steady-state simulation of the gasifier. Since the gasifier output controls the performance of the gas clean-up system, it is necessary to investigate the effects of steam/coal and oxygen/coal ratios and of feed temperature on the gasifier output. Simulation of the gasifier performance, therefore, was undertaken to gain quantitative understanding of these effects. This gasifier simulation program will be coupled with a gas clean-up system simulation program now under development. Simulation of the entire gasifier system will serve as a guideline in planning experiments to enable its optimum overall operation.

28272 (DOE/OR/20687—T1) **Wear-resistant materials for coal conversion and utilization. First progress report, October 1979-April 1980.** Block, F.E.; Kelley, J.E.; Leavenworth, H.W. Jr. (Bureau of Mines, Albany, OR (USA). Albany Metallurgy Research Center). 1980. Contract W-7405-ENG-26;AI05-80OR20687. 30p. NTIS, PC A03/MF A01.

Studies of wear-resistant materials were concentrated mostly on hard coatings and surface treatments, such as chemical vapor deposited materials, thermal-sprayed materials with post-deposition laser treatments, and surface-bonded materials. Several coatings were found to have extremely good erosion resistance. A nickel-bonded titanium diboride material was found to have extremely high erosion resistance. An erosion data bank for existing and promising valve materials was begun. Erosion test results at six impingment angles and four particle velocities were produced. Testing of a 6-inch ball-valve ball coated with a Cr-Ni-B coating in a laboratory ball-valve testing facility reached the half-way point; 10,000 open-close cycles in coal-ash.

28273 (FE—1514-113) **Advanced coal gasification system for electric power generation. First quarterly progress report, FY-1080, October 1-December 31, 1979.** Salvador, L.A. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Coal Conversion Dept.). 25 Jan 1980. Contract AC01-76-ET10161. 74p. NTIS, PC A04/MF A01.

The results of PDU tests TP-025-1, -2, and -3 are reported. A review of the data and the effect of various modifications on cyclone deposits was conducted. It is tentatively concluded that the mechanism of deposit formation is the result of sticky particles or liquid droplets out of the combustion and/or gasification zone impacting on the hot refractory cyclone walls as a result of change in direction of flow. Also, there must be different glue generated from Ohio No. 9 coal as compared with Pittsburgh seam coal. The most effective modification to date for alleviating cyclone deposits has been a water spray nozzle which was installed in the freeboard area of the gasifier to quench particles with a liquid film and render them nonsticky. During test TP-025-2 water spray in the freeboard area of the gasifier was used to cool the gas and particles from 1800°F to 1300°F. At this temperature, the deposit was practically eliminated. However, long-duration tests with Pittsburgh seam and Ohio No. 9 coals are necessary before any firm conclusions can be drawn about the effect of water spray. Significant progress was made in the construction of the cold-flow, scale-up facility. In addition, studies were made on the reactivity of various chars in the laboratory fluidized bed. Leaching studies on ash from test TP-020-2 agglomerates were completed using Westinghouse standard leach acts.(LTN)

28274 (FE—1792-55) **Coal Feeder Developme t Program. Quarterly technical progress report, January-March 1979.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 23 Mar 1979. Contract EX-76-C-01-1792. 91p. NTIS, PC A05/MF A01.

Results of further component testing for the critical parts of the Kinetic Extruder are reported. Additional validation testing of the Model 3 rotor was carried out, and the test data are shown to confirm computer-based predictions. Performance maps are shown for delivering pulverized coal to a nitrogen atmosphere and also to a hydrogen atmosphere.

28275 (FE—1793-50) **Coal Feeder Development: Phase III. Progress report, July 1, 1978-December 31, 1978.** Harding, J.C. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jun 1979. Contract EX-76-C-01-1793. 31p. NTIS, PC A03/MF A01.

This report covers Phase III effort on the Foster-Miller Associates, Inc. (FMA) Coal Feeder Development Program from 1 July 1978 to 31 December 1978. At the end of this period, the FMA

Linear Pocket Feeder (LPF) had been operated for 234 hours. Problems with the unit have been limited to excessive wear of the conveyor joints. This problem is expected to be relatively easy to solve. Design, fabrication, and assembly of the 500 psig Centrifugal Feeder prototype was completed during the reporting period, and testing of the feeder was initiated. The enlarged feeder test facility (5-ton capacity) was completed.

28276 (FE—2012-100) **Pipeline Gas Demonstration Plant: Phase I. Annual technical progress report, June 1979-May 1980.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jun 1980. Contract AC01-77ET13031. 95p. NTIS, PC A05/MF A01.

During the past year, work activity and progress was adversely affected by the following major factors: Delay in obtaining timely Government review of the Process Design Baseline Packages; additional support during DOE Contract Performance Evaluation; and revisions required to data and documentation for Contract Modification A020. The dominant work activity has been the continued effort to complete Task II. Finalizing of the PDBP's has permitted the opening of most process areas for Task VI, Definitive Design effort. The final Task II product will be the DPPD. In order to complete Phase I per the current schedule, it is imperative that Task VI proceed in a prompt and effective manner. Progress and schedule will be delayed by any new DOE informational requests or delays in obtaning required approvals. Based upon the achievements of the past year and predicted on no new problems occurring, the program should progress in an orderly and effective manner in the next year. A list of Task Reports submitted during the past year is provided.

28277 (FE—2229-12) **Surface structure and mechanisms of gasification catalyst deactivation. Final report.** Reucroft, P.J.; Bradley, E.B.; De Angelis, R.J.; Sargent, G.A. (Kentucky Univ., Lexington (USA)). Mar 1980. Contract AC01-76ET10455. 114p. NTIS, PC A06/MF A01.

Considerable information has been obtained on the chemical state of nickel in typical coprecipitated alumina and silica supported nickel catalysts. In these catalysts it appears that a significant fraction of the metal is chemically complexed with the support material forming aluminate and silicate, respectively, in alumina and silica supported catalysts. This leads to incomplete reduction of nickel at low temperatures, resulting in less metal being available in a catalytically active form. Recent studies indicate that less metal-support interaction takes place in magnesium silicate-supported nickel catalysts. Studies on the effect of time and temperature on the nickel particle size distribution in unreduced (nickel oxide) and reduced (nickel metal) catalysts indicate that the sintering mechanism, which leads to a larger average particle size, appears to be different in the two forms of the catalyst. ESCA studies on sulfided alumina and magnesium-silicate supported nickel catalysts and sulfided magnesium-silicate supported nickel-chromium catalysts indicate that a significant fraction of the sulfur acquired by the catalysts appears to be in the sulfate form in the nickel-chromium catalysts. The interaction of carbon monoxide at the nickel (111) surface has been investigated by LEED, auger spectroscopy and laser Raman spectroscopy. The results indicate that carbon monoxide dissociates into a complex form at temperatures higher than 100°C. Thirteen papers herein have been entered individually into EDB and ERA. (LTN)

28278 (FE—2229-12, pp 9-10) **Quantitative analysis of ESCA signal intensities from coprecipitated nickel on alumina catalysts.** Shalvoy, R.B.; Reucroft, P.J. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

Heterogeneous catalysts are complex, non-uniform, systems. ESCA has been applied to a variety of simple and complex systems, often providing valuable information on the surface electronic structure. Increasingly, ESCA has been used to characterize heterogeneous catalyst systems. Positive correlations between ESCA peak intensities and catalyst properties, such as dispersion and particle size have been obtained from a quantitative analysis of the ESCA spectra. These results indicate that ESCA data, properly interpreted, can provide much basic information on catalysts in addition to characterizing the charge state of the dispersed metal. We have been investigating a series of coprecipitated nickel oxide/alumina methanation catalysts. Catalysts prepared by this technique have not been extensively studied using ESCA. In addition, these samples have a higher metal content (10 to 47% nickel, by weight) than previously studied catalysts. As the method of preparation appears to have an influence on the properties of the catalysts, it is of interest to learn how the coprecipitation method affects the ESCA spectra, and hence the properties of the catalyst itself. The catalyst samples were prepared by coprecipitation of a nickel salt with an aluminum salt to obtain carbonates of nickel and aluminum. The samples were then calcined to their oxide states. This method of preparation has yielded very active catalysts following reduction of the nickel oxide to nickel metal.

28279 (FE—2229-12, pp 11-20) **Characterization of coprecipitated nickel on silica methanation catalysts by x-ray photoelectron spectroscopy.** Shalvoy, R.B. (Univ. of Kentucky, Lexington); Reucroft, P.J.; Davis, B.H. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

An x-ray photoemission spectroscopy study of a series of standard nickel compounds (Ni, NiO, $Ni(OH)_2$, and $NiSiO_3$) and silica-supported nickel methanation catalysts has been conducted. The binding energies and spectral shapes of the standard samples provide a data base which has been used to understand the catalyst spectra. The activity and thermal stability of coprecipitated nickel catalysts has been attributed to the metal-support interaction. This interaction has been observed in two coprecipitated nickel-on-silica catalysts. The nickel spectra closely resemble those of amorphous $NiSiO_3$. The interaction varies somewhat between the two catalysts studied, as evidenced by the differences in their reducibility.

28280 (FE—2229-12, pp 21-31) **Particle size distribution function of supported metal catalysts by x-ray diffraction.** Ganesan, P. (Inst. of Mining and Minerals Research, Lexington, KY); Kuo, H.K.; Saavedra, A.; De Angelis, R.J. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

An x-ray diffraction method which is capable of determining average particle size, microstrain, and the particle distribution function existing in crystalline materisls is presented. The method is based on the analysis of a single x-ray diffraction profile. Results obtained on coprecipitated nickel oxide on alumina- and silica-supported catalytic materials indicate that appreciable strains exist. It is suggested that the strains present in NiO could be due to the pressure developed in the small particles to balance the surface tension forces and the distortion produced by the deformation of face-centered cubic structure into a rhombohedral form. The changes in particle size distributions observed during sintering determined from three catalytic materials provide evidence that particle growth takes place by atomic migration mechanism. In one material the particle growth during sintering appears to be controlled predominantly by crystallite migration and coalescence. The sintering behavior appears to be controlled by the extent of the bimodal character of the initial distribution function and the average particle size in the as-received condition.

28281 (FE—2229-12, pp 32-35) **Characterization of a sulfur-resistant methanation catalyst by XPS.** Shalvoy, R.B. (Inst. for Mining and Minerals Research, Lexington, KY); Reucroft, P.J. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

A Ni-Cr on $MgSiO_3$ catalyst has been developed by United Catalysts, Inc. This catalyst converts 60 percent of the input CO to CH_4 after a heavy presulfiding treatment that reduces the CO conversion of conventional catalysts to less than 10 percent. The unsilfided conversion is better than 95%. X-ray photoemission spectra obtained from a series of untreated sulfided, and methanation-tested Ni and Ni-Cr on $MgSiO_3$ catalysts show the presence of nickel sulfide in catalysts which are deactivated by the sulfiding. Both nickel sulfide and nickel sulfate are found in the catalysts that retain appreciable methanation activity. The amount of sulfur in the active catalysts is also appreciably less than in the inactive catalysts. The relationship between the resistance to sulfur poisoning and the presence of Cr and $MgSiO_3$ is discussed.

28282 (FE—2229-12, pp 36-41) **Particle-size distribution of NiO in coprecipitated $NiO-Al_2O_3$ powders.** Kidron, A. (Univ. of Alabama, Huntsville); De Angelis, R.J.; Reucroft, P.J. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

The particle-size distribution along the [100] and [111] directions of NiO catalyst particles coprecipitated with alumina were measured by x-ray diffraction profile analysis. The average particle size is about 20 A in both directions. The distribution along the [111] direction shows three peaks, indicating an anisotropy in the shape of the particles, and supports the idea that the particles are platelets with the [111] direction normal to their surface. This study shows beyond doubt that careful x-ray diffraction profile analysis techniques employing least-squares analysis methods can be used to determine the distribution of particle sizes existing in metal supported catalyst materials.

28283 (FE—2229-12, pp 46-49) **Raman spectra of CO, H_2 and O_2 adsorbed on Ni(111).** Stencel, J.M.; Bradley, E.B. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

Experimental results are discussed for laser Raman spectra which are obtained from Ni(111) after this surface is exposed to CO, H_2, and O_2 in the 300°C temperature region. A major Raman band is observed at 80 cm^{-1}. Intensity variations in this band are shown with

respect to CO, H_2, and O_2 exposure and evacuation. The discussion described possible surface species which could produce the observed spectra and compares them with graphitic chemilayers which have been observed in similar adsorption studies.

28284 (FE—2229-12, pp 54-57) **Structural changes in a sulfur-resistant methanation catalyst as determined from infrared spectra.** Stencel, J.M.; Heinz, R.E.; Bradley, E.B. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

The infrared spectrum of a sulfur-resistant $NiO/Cr_2O_3/MgAl_2O_4$ methanation catalyst is presented and compared to the spectra of the catalyst after it was reduced, sulfided, and tested for methanation activity. The molecular structure of the catalyst is shown to be represented by NiO and MgO dispersed in a quasitridimensional Cr-O-Al network. Reduction and sulfiding reorders this network and alters the AlO/sub n/ coordination while reducing Cr^{6+} to Cr^{3+} or Cr^{2+}. The sulfided and methanation-tested catalyst has intense sulfate absorption indicative of sulfur which is coordinated with NiCr and/or NiMg sites.

28285 (FE—2229-12, pp 58-62) **Infrared spectra of some nonreduced methanation catalysts.** Bradley, E.B.; Stencel, J.M. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

The infrared spectra (4000 to 400 cm^{-1}) of two commercial, nonreduced methanation catalysts are recorded and interpreted. The catalysts were prepared as mixtures of (a) nickel in a silica support, and (b) nickel in a alumina support. Graphite was added to these mixtures as a binder to facilitate pressing of catalyst pellets for commercial use. It is revealed in the spectra of the catalysts that although (a) is prepared to have a simple NiO/SiO_2 compositon, the silica support is not of the form SiO_2; rather, the spectral characteristics are similar to those found for linear chain silicates. In (b) the Al-O vibrations are characteristic of amorphous Al_2O_3, and H_2O is tightly bound in the pellet. The CO_3 /sup =/ ion is present in both (a) and (b). It is not bound to Ni in either (a) or (b), but is bound in the silicate structure of (a) and associated with Al in (b). The presence of the ion cannot be explained by only in situ generation from atmospheric CO_2 and H_2O, but its presence must be due to residual CO_3 /sup =/ from the catalyst preparation.

28286 (FE—2229-12, pp 63-66) **Raman spectra of carbon monoxide adsorbed on oriented crystalline nickel surfaces.** Stencel, J.M.; Bradley, E.B. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

Raman spectral results for CO adsorbed at high pressures on Ni(100), Ni(110), and Ni(111) are presented. The bands near 2020 cm^{-1} due to chemisorbed CO are discussed in relation to site of adsorption and surface cleanliness. Raman spectra of temperature and pressure-dependent CO adsorption on Ni(100) are also presented.

28287 (FE—2229-12, pp 68-76) **Method to study sintering of a supported metal catalyst.** Kuo, H.K.; Ganesan, P.; De Angelis, R.J. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

An x-ray single-profile analysis method has been used to monitor the changes in the average nickel particle sizes and particle size distributions during sintering of a silica-supported nickel catalyst. Sintering was carried out in nitrogen and hydrogen atmospheres at temperatures from 500 to 800°C for times varying from 5 to 100 hours. The particle size distribution functions determined both by the x-ray single order line profile analysis and by transmission electron microscopy were in excellent agreement. The sintering process occurred very rapidly initially and then proceeded more slowly at longer times at the higher temperatures. The effects of sintering temperature on the changes of PSD were found to be much more pronounced than the effects of sintering time. As sintering progressed, the particle size distributions developed long tails to the large diameter side. The changes in the particle size distributions tend to indicate that the probable sintering mechanism for the silica-supported nickel catalyst is one associated with particle migration.

28288 (FE—2229-12, pp 77-82) **Infrared and Raman spectra of a sulfur-resistant methanation catalyst.** Stencel, J.M. (Univ. of Kentucky, Lexington); Bradley, E.B.; Brown, F.R. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

The infrared and Raman spectra of a sulfur-resistant $NiO/Cr_2O_3/MgSiO_3$ methanation catalyst are presented and compared to the spectra of the catalyst after being reduced, sulfided and tested for methanation activity. The molecular structure of the catalyst after being reduced, sulfided and tested for methanation activity. The molecular structure of the catalyst is shown to be represented by NiO and MgO dispersed in a quasi-tridimensional Cr-O-Si network. Reduction and sulfiding reorders this network and alters the SiO/sub n/ coordination while reducing Cr^{6+} to Cr^{3+} or Cr^{2+}. The data indicate that the SO_4^{-2} present after sulfiding and methanation testing may have been formed during the methanation reaction.

28289 (FE—2229-12, pp 83-91) **Studies of the metal-support interaction in coprecipitated nickel on alumina methanation catalysts using x-ray photoelectron spectroscopy (XPS).** Shalvoy, R.B.; Davis, B.H.; Reucroft, P.J. (Univ. of Kentucky, Lexington). Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

Characterization studies on a series of coprecipitated alumina supported nickel methanation catalysts by x-ray photoelectron spectroscopy (XPS) are described. Binding energies and spectral shapes have been determined for several standard compounds (Ni, NiO, $Ni(OH)_2$, $NiAl_2O_4$, Al_2O_3) to provide background information for interpreting the catalyst spectra. The results indicate that the surface regions of the fresh (unreduced) catalysts are composed primarily of amorphous $NiAl_2O_4$ with some NiO particle present either within the pores of the support or covered by a $NiAl_2O_4$ layer. In comparison with similarly prepared silica supported catalysts, reducibility is more difficult, indicating the presence of stronger support interactions.

28290 (FE—2542-27) **Phase I: the Pipeline Gas Demonstration Plant. Quarterly technical progress report, 1 January 1980-31 March 1980.** Watson, W.B. (comp.). (Conoco, Inc., Stamford, CT (USA)). Apr 1980. Contract AC01-77ET13060. 69p. NTIS, PC A04/MF A01.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy requires Conoco Inc. to design, construct, and operate a demonstration plant for the manufacture of high-Btu gas from bituminous coal. The project is currently in the design phase. The main accomplishments during the reporting period were: (a) the process design of the Demonstration Plant was essentially completed except for the design report; (b) an order of magnitude (+- 30%) estimate of 248 million dollars (January 1980 dollars) for the erected cost, including land, for the Demonstration Plant was prepared; (c) a six-volume Environmental Report was issued, and Oak Ridge National Laboratory prepared a preliminary draft of the Environmental Impact Statement; (d) preparation of a draft of the application for a Prevention of Significant Deterioration permit was prepared and sent to Region V of the Federal Environmental Protection Agency for review and comment; and (e) a document supporting the selection of the Demonstration Plant being designed under the contract was sent to DOE.

28291 (FE—2621-13) **Weld overlaying for corrosion resistance in coal gasification atmospheres.** Sadowski, E.P. (International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center). 1979. Contract EF-77-C-01-2621. 65p. NTIS, PC A04/MF A01.

Hardness and tensile testing of weldments which were exposed to a 1% H_2S coal gasification atmosphere for 1000 hours at 982°C (1800°F) was completed. Corrosion evaluation of unwelded specimens of 304L, 310 SS and INCOLOY alloy 800H was completed also. The INCONEL Filler Metal 72 and R139 overlays increased and the AWS-ER309 overlays decreased in hardness after exposure. The welding process used had very little effect on the response of the FM-72 overlays, while the R139 deposited by the SAW process had the least increase in hardness. The latter may be associated with the lower Al recovery obtained with the SAW process. Generally, the heat-affected zone and base metals of all weldments decreased in hardness after exposure. All weldments decreased in room temperature yield and tensile strength after exposure. Most weldments suffered a decrease in tensile ductility. The 310 weldments had the largest percentage decrease and the 304L weldments the last percentage decrease in the original tensile ductility after exosure. The corrosion atmosphere was considered to be very severe based upon the degree of corrosion obtained in the unwelded substrates. The 304L was totally consumed as mixed oxides and sulfides. Alloy 800H was severely attacked with the formation of liquid sulfide scales and extensive oxidation. Type 310 stainless steel exhibited the best resistance to the environment and was only modestly attacked in three of four samples. The R139 and INCONEL Filler Metal 72 overlays appeared to be extremely corrosion resistant to the CGA atmosphere. A comprehensive evaluation is in progress.

28292 (GFETC/IC—79/1, pp 207-231) **Technical, economic, and environmental factors for in-situ gasification of Texas lignite.** Edgar, T.F.; Kaiser, W.R.; Humenich, M.J.; Cooper, H.B.H. (Univ. of Texas, Austin). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Deep basin lignite in Texas cannot be economically recovered by surface or underground mining. For such lignites, underground coal gasification (UCG) appears to be an attractive alternate for production of low- to medium-Btu gas which may be used in a mine-

mouth combined cycle powerplant for process heat, or as a chemical feedstock. There are presently two industrially-sponsored field testing programs in operation on Texas lignite. Geological, engineering, and environmental factors are discussed as applied to UCG. Critical geologic factors for site selection are generally more favorable in the Jackson Group than in the Wilcox Group. Resources suitable for UCG are from 10 to 20 billion tons. Water quality impacts, possible organic and inorganic pollutants, and effects on air quality from UCG are reviewed. Many environmental questions are under investigation. Operational features and design variables such as product gas quality, water influx, gas leakage, seam thickness, production pressure, well spacing, and sweep efficiency are evaluated. A first generation technology has been achieved using air injection, while oxygen injection operation needs additional testing. Economics of UCG indicate lower capital equipment costs and generally a more attractive situation than for conventional mining plus surface gasification.

28293 (GFETC/IC—79/1, pp 236-277) **Slagging fixed-bed gasification: project status at the Grand Forks Energy Technology Center.** Ellman, R.C.; Paulson, L.E.; Hajicek, D.R.; Towers, T.G. (Dept. of Energy, Grand Forks, ND). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Major modifications to the gasifier and pilot plant should be completed in late 1979 to allow for extended operation and for use of agglomerating coals. During 1976 to 1978, 66 runs were attempted with accumulation of 263 hours of slagging operation using five coals - three lignites and two subbituminous. Operating pressures ranged from 200 to 400 psig, oxygen-feed rates were from 4000 to 6000 scfh, and the oxygen/steam molar ratio was 1.0. $CO + H_2$ in product gas was over 80%, oxygen-consumption was between 5 to 6 scf/lb maf fuel, and steam usage approximately 0.25 lb/maf fuel. Gas production was from 23 to 28 scf of $(CO + H_2)$/lb maf fuel. Operation was coal specific in that lignite with greater than 40% moisture was not successfully gasified, and coal ash characteristics determined effectiveness of slagging. Flux additions were required for subbituminous coals. Various hearth plate materials, types of cooling coils, tap hole inserts, and hearth-plate heating designs were tested. A specially designed metal water-cooled hearth plate exhibited best potential for extended service. Extensive sampling of liquid effluents was done by several methods, and modified analytical techniques were developed for total and specific organics and for trace elements. Biological treatment of liquid wastes is beng investigated on a contract basis.

28294 (GFETC/IC—79/1, pp 278-287) **First experimental results on operation of the high temperature Winkler process in a semi-technical plant.** Franke, F.H.; Pattas, E.; Adlhoch, W. (Rheinische Braunkohlenwerke AG, Cologne, Germany). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Since July 1978, a 1.1 tpd pressurized, high-temperature Winkler pilot plant has been operated at Frechen. By January 1979, approximately 330 tons of dried brown coal were gasified at pressures to 130 psi and temperatures to 1740°F. Air, oxygen plus carbon doxide, or oxygen plus steam were used as gasification agents. Runs were of two to three weeks duration. Pressure operation was without serious mechanical problems. Modifications in treatment of dust loaded product gas are still required. Target parameters were reached in product gas composition, specific yields of CO and H_2, carbon conversion, and specific reactor performance. Product gas contained up to 95% of $(CO + H_2)$ and carbon conversion was about 90%. Addition of limestone, lime, or dolomite to the coal feed increased ash fusion and removed sulfur from the gas. Gasifier and process schematics are presented.

28295 (GFETC/IC—79/1, pp 288-297) **Experimental results on operation of the hydrogasification of lignite in a semi-technical plant.** Theis, K.A.; Langer, H. (Rheinische Braunkohlenwerke AG, Cologne, Germany). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Hydrogasification is a viable process for production of synthetic natural gas. The necessary hydrogen can be produced by gasification of residual char from coal hydrogenation followed by the water-gas-shift reaction or by reforming part of the product gas in a nuclear-heated steam reformer. Dried pulverized coal is hydrogenated in a fluidized bed reactor with residual char removed from the bottom. The product gas containing some entrained char is removed from the top of the reactor. The char is mechanically separated from the gas, which is then cooled to remove condensibles. Data are reported from a 0.4 tph of raw lignite unit, which is the basis for design of a semitechnical plant of 25 tph capacity. The small unit has been operated for more than 13,700 hours with coal throughput. Methane content of the crude gas was about 50%, with 70% of the carbon gasified when the unit was operated between 1550 and 1740°F at 54 to 93 atmospheres.

28296 (GFETC/IC—79/1, pp 298-316) **Overview of the Great Plains Gasification Associates Coal Gasification Project.** Fodor, R.J. (American Natural Service Co., Detroit, MI). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

In 1972, Michigan Wisconsin Pipe Line Co. announced plans for a 250 million scfd SNG plant for Mercer County, ND, and in 1975, a subsidiary, ANG Coal Gasification Co., was formed. In March of 1977, Peoples Gas Company became a full partner. Continued difficulty was encountered with obtaining financing, and following a suggestion from DOE, the Great Plains Gasification Associates was formed. The association consisted of five companies supplying gas to 30 states and about one-third of all interstate pipeline customers. Additionally, agreement was reached with North American Coal Corp. for lease of lignite deposits and with Basin Electric Power Cooperative on a joint plant concept. Of all the necessary permits for a 125 x 10^6 scfd of SNG plant, only the FERC Certificate of Convenience and Necessity has not been obtained. No additional work will be done on the project until approval by the FERC. Assuming approval in July of 1979, detailed engineering will start at once with first construction planned for April 1980. Plant start-up would be scheduled for April 1983, and full gas production estimated for December 1983. The second phase (an additional 125 x 10^6 scfd of SNG plant) would start in 1984-1985. Details of the mining operation, lignite preparation, gasification, synthesis of SNG and clean-up are presented. Cost data are given showing that inherent price stability makes SNG production from lignite an attractive alternative energy source.

28297 (GFETC/IC—79/1, pp 317-334) **Gasifiers in industry: experiences during design and operation.** McGurl, G.V.; Miller, L.C.; Strom, A.H.; Klein, E. (Dept. of Energy, Washington, DC). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The Department of Energy's Gasifiers in Industry program was initiated in 1976 to expand the information base concerning costs, operation, and environmental and industrial hygiene practices for small industrial gasifiers. Advantages and disadvantages of the three basic types of industrial gasifiers - single-stage fixed bed, two-stage fixed bed and fluidized bed - are reviewed. Experiences of five companies in the United States using single-stage fixed bed gasifiers are summarized. Ten new installations are planned, under construction, or in start-up mode. Mechanical, operational, and environmental problems in initial operation are discussed, with emphasis on the unit at the University of Minnesota-Duluth. The DOE/Pikeville, Kentucky, unit is also mentioned.

28298 (GFETC/IC—79/1, pp 335-350) **Synthetic natural gas from peat.** Rader, A.M. (Minnesota Gas Co., Minneapolis). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The United States, with the second largest peat resource in the world, has not used peat commercially for energy, as has been done in several other countries. Data on peat resources are presented. Since 1974, the Minnesota Gas Company has been investigating the possibilities of producing SNG from peat. Laboratory and process development unit work at IGT under a Minnegasco-DOE contract was favorable, as the higher reactivity of peat allowed hydrogasification at lower pressures and temperatures than for coal. The selected configuration for gasification and a schematic process-flow sheet are presented. Operation between 200 and 500 psia at temperatures from 1400 to 1900°F in the two-stage gasifier results in 98% carbon conversion with 80% of the total CH_4 produced in the gasifier. Cost estimates from a complete process design for a 250 x 10^9 Btu/day plant indicate a $1.19 billion capital investment in 1978 dollars and a SNG cost of $3.06/$10^6$ Btu for the base case. Proposals have been submitted to DOE for pilot-plant testing in a modified Hygas unit. Laboratory scale research on biogasification are encouraging, with conversion of 90% of ash-free peat into soluble products that can be converted into CH_4 and CO_2 by anerobic fermentation.

28299 (MTI—79TR5) **Assessment of Synthane mechanical equipment. Technical report.** McCabe, J.T.; Kramberger, F.E.; Hao, B.R.; Dubis, D.; Carson, S.E. (Mechanical Technology, Inc., Latham, NY (USA)). May 1980. Contract AC01-77ET10622. 164p. NTIS, PC A08/MF A01.

Mechanical equipment in the Synthane pilot plant was subjected to operating conditions outside manufacturers' specifications. In some cases, these encounters were intentional and in other cases they resulted from insufficient data. All 106 of the test runs were terminated involuntarily. For the most part, the repetitive failures of plant materials and equipment originated from a combination of excessive solids overloading and corrosion/erosion caused by abnormal conditions of operation on fluid process streams. The extremes of these conditions were not anticipated nor were they taken into consideration in the design of the plant and in the selection of equipment and materials. Because of this situation, approximately half of the test run terminations were directly attributed to mechanical failures. Generally, for reasons given the maintenance, repair or

replacement of failed equipment was not successful in eliminating or alleviating many failures until early 1978. Appropriate early planning can eliminate all these causes of failure in the future. Factors contributing to the difficulties in maintenance, repair, and replacement of failed materials and equipment are listed. In future construction, heavy reliance should be placed on engineering assessments of the equipment selection specifications, acceptance procedures, and the manner in which the equipment is installed, interconnected and operated. It is recommended that an effective and responsive data collection system on equipment specifications, operating conditions, performance, maintenance and repairs of critical equipment be incorporated as part of each pilot and demonstration plant effort. This step is essential to define required operating environments, equipment capabilities, failure histories, equipment and process interactions, as well as plant performance.

28300 (SAN—1429-60) **Molten Salt Coal Gasification Process Development Unit. Quarterly technical progress report No. 15, October-December 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 16 Jan 1980. Contract AC03-77ET10296. 22p. NTIS, PC A02/MF A01.

This represents the fifteenth quarterly progress report on the Molten Salt Coal Gasification Process Development Unit (PDU) project. The project includes the design, construction, and operation of a PDU which will convert 1 ton of coal per hour into low-Btu gas. During the period covered by this report, relining of the gasifier and installation of an improved melt withdrawal system were completed. The gasification system was sealed, pressure tested, and operationally checked out in preparation for Test Run 4. The objective of PDU Test Run 4 is to demonstrate gasification operations up to 10 atmospheres at coal-feed rates up to 1 ton per hour.

28301 (UCRL—84083) **Implications of ground-water measurements at the Hoe Creek UCG site in northeastern Wyoming.** Mead, S.W.; Wang, F.T.; Stuermer, D.H.; Raber, E.; Ganow, H.C.; Stone, R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 27p. (CONF-800716—12). NTIS, PC A03/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Underground coal gasification (UCG) promises to become an important source of synthetic fuels. In an effort to provide timely information concerning the environmental implications of the UCG process, we are conducting investigations in conjunction with the UCG experiments carried out in northeastern Wyoming by the Lawrence Livermore National Laboratory. Our ground-water quality measurements have extended over a period of four years and have been supplemented by laboratory studies of contaminant sorption by coal. Cavity roof collapse and aquifer interconnection were also investigated, using surface and subsurface geotechnical instruments, post-burn coring, and hydraulic head measurements. We have found that a broad range of residual gasification products are introduced into the ground-water system. Fortunately, the concentrations of many of these contaminants are substantially reduced by sorption on the surrounding coal. However, some of these materials seem likely to remain in the local groundwater, at low concentrations, for several years. We have attempted to interpret our results in terms of concepts that will assist in the development of effective and practicable control technologies.

28302 (UCRL—84584) **Early cavity growth during forward burn.** Shannon, M.J.; Thorsness, C.B.; Hill, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Jul 1980. Contract W-7405-ENG-48. 6p. (CONF-800716—11). NTIS, PC A02/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

During the early portion of the forward burn phase of the Hoe Creek III field experiment, the cavity progagated rapidly down the deviated borehole and to the top of the coal seam. As a first step to understanding this phenomena we have conducted small scale coal block experiments. Drying as well as combustion tests were performed. This paper describes the test hardware and the experimental results.

28303 **Update on lockhopper valve development.** Gardner, J.F. (Morgantwon Energy Tech. Center, WV). *Mater. Compon. Newsl.;* No. 26, 1-2(1 Feb 1980).

Currently, 20 valve designs have been evaluated through various phases. Early test results have been somewhat disappointing. Valve failures have been numerous, with many occurring during the clean, dry gas static testing at elevated temperature. These failures have been a continual hindrance to obtaining the overall project goals. Based on early testing, it is evident that for state of the art valve products to be successful in these applications, the following items need attention by valve manufacturers: better quality control of manufactured product, both in manufacture and during assembly; better understanding of valve applications in coal conversion and utilization; better valve testing data base, especially at elevated pressure and temperature in combustion; better procedures for maintenance, operation, and assembly of the product; and better knowledge of mating materials, combinations suitable for abrasive or erosive service in coal conversion, and utilization valve applications. The overall success criteria for a State-of-the-Art Lockhopper valve has been set at 20,000 operational cycles without refurbishment, which represents about 9 to 10 months of plant operation.

28304 **Structural integrity of vessels for coal conversion systems.** Canonico, D.A. (Oak Ridge National Lab., TN). *Mater. Compon. Newsl.;* No. 26, 4-6(1 Feb 1980).

Structural integrity can be expected in large, thick walled coal conversion pressure vessels if they comply with the following conditions: 1. They are built in accordance with the requirements of the ASME and/or ANSI Codes. 2. The multidisciplined approach to design, material selection, and fabrication is adhered to, and communication between these groups is maintained. 3. The fracture toughness requirements imposed by experienced and reputable companies, which are considerably beyond those required by the Code, become the standard for the industry. 4. The sharing of technological developments is continued and, indeed, is increased. 5. The role of materials in the success of any conversion system is emphasized and assumes its rightful place in the development of coal conversion technology. There will be no industry if process and material development are not wed in pilot plant as well as demonstration plant facilities. 6. In-service surveillance programs are included in the operational plans for coal conversion systems. 7. The effect of the process environments on the mechanical properties of the pressure containment components is adequately established.

28305 **HYGAS Process: pipeline gas from coal.** Tarman, P.B. Chicago, IL; Institute of Gas Technology (1980). 14p. (CONF-800642—1).

From International gas research conference; Chicago, IL, USA (9 Jun 1980).

The HYGAS Process can convert all types of coals, both caking and noncaking, to high-Btu substitute natural gas that is completely interchangeable with natural gas. A 3 ton/hr pilot plant located in Chicago, Illinois, has been successfully operated with Montana lignite, Rosebud subbituminous coal, and four different caking Illinois Basin bituminous coals. Data obtained with Illinois No. 6 coal have been used by Procon Inc., under a separately funded Department of Energy contract, to develop both commercial and demonstration plant designs. The HYGAS pilot plant is currently being operated with Western Kentucky bituminous coal, to obtain long steady-state operating periods and to further develop the data base for the design of demonstration and commercial plants.

28306 **U-GAS Demonstration Plant Program.** Patel, J.G.; Gray, R.W. Chicago, IL; Institute of Gas Technology (1980). 17p. (CONF-800642—2).

From International gas research conference; Chicago, IL, USA (9 Jun 1980).

Memphis Light, Gas and Water (MLGW) and the US Department of Energy (DOE) have a joint program to design, construct, and operate an industrial fuel gas demonstration plant in Memphis, Tennessee. The plant will use the Institute of Gas Technology's U-GAS Process to produce fuel gas equivalent to 50 million cubic feet per day of natural gas from 3200 tons of Western Kentucky coal. During Phase I of the program, main activities have been design of the plant, operation of the U-GAS pilot plant, the compilation of an environmental report and a definitive plant cost estimate. Phases II and III negotiations with DOE are being finalized. The total cost of Phases II and III is to be cost-shared by DOE and MLGW. The demonstration plant program's goal is to test the feasibility of a multiple-user coal gasification plant located in an urban area.

28307 **Materials for coal gasification effects of environment on properties.** Contract EX-77-C-01-2716. *Mater. Compon. Newsl.;* No. 25, 1-8(1 Dec 1979).

Although this testing program is incomplete, it is possible to reach a few tentative conclusions concerning the suitability of some of the candidate alloys for structural applications in coal gasification environments. The high cobalt alloys clearly showed the best stress-rupture strengths at 1800F in CGA. At 1200 and 1500F, several alloys show reasonable stress-rupture strengths in CGA. The tensile test results obtained to date indicate no major problems, although CGA exposures do have a detrimental effect on ductilities for a number of the alloys and weldments tested. The very low room-temperature impact energies of some of the alloys and the general degradation in impact properties with extend elevated-temperature exposures are also causes for concern.

28308 **Refractory CO_2 acceptor gasifier lining reviewed.** Contract EX-77-C-01-2716. *Mater. Compon. Newsl.;* No. 24, 1-8(1 Oct 1979).

Laboratory examination of several of the refractory materials used in lining this gasifier led to the conclusion that the use of 50

percent silica-alumina castable material in hydrogasification environments results in reasonably good material life and performance. The beneficial effects of increased compressive strength and erosion resistance by steam leaching of the refractories, in conjunction with the interaction of alkali from the lignite and lime from the acceptor, far outweigh any observed degradation, at least at this stage of the liner's service life. Whether further reaction would occur with continued exposure and whether further reaction would enhance performance or cause deterioration cannot be determined.

28309 **Coal gasification: department of energy program approach.** Wilson, J.S. (Morgantown Energy Tech. Center, WV). *Trans. Am. Nucl. Soc.;* 33: 14(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

LIQUEFACTION

REFER ALSO TO CITATION(S) 28263, 28265, 28269, 28272, 28304, 28337, 29192

28310 (DOE/ET/10583—T1) **Development and application of analytical techniques to chemistry of donor solvent liquefaction. Final report, August 31, 1977-December 31, 1979.** Squires, A.M.; Dorn, H.C.; Taylor, L.T.; Dillard, J.G.; Rony, P.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1979. Contract FG01-77ET10583. 41p. NTIS, PC A03/MF A01.

The scope of this project was to develop and apply analytical techniques for the characterization of coal conversion products. Solvent-refined coal served as the coal-derived material for the duration of the study. The investigation has focused primarily in the areas of separations and nuclear magnetic resonance spectroscopy. Highlights of the twenty-eight month study are listed and followed by a brief synopsis of the major findings.

28311 (DOE/FE—0003/79/2) **Coal liquefaction. Quarterly report, April-June 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Apr 1980. 65p. NTIS, PC A04/MF A01.

DOE's program for the conversion of coal to liquid fuels was begun by two of DOE's predecessor agencies: Office of Coal Research (OCR) in 1962, and Bureau of Mines, US Department of the Interior, in the 1930's. Current work is aimed at improved process configurations for both catalytic and non-catalytic processes to provide more attractive processing economics and lower capital investment. The advantage of coal liquefaction is that the entire range of liquid products, especially boiler fuel, distillate fuel oil, and gasoline, can be produced from coal by varying the type of process and operating conditions used in the process. Furthermore, coal-derived liquids have the potential for use as chemical feedstocks. To provide efficient and practical means of utilizing coal resources, DOE is supporting the development of several conversion processes that are currently in the pilot plant stage. DOE, together with the Electric Power Research Institue, has contracted with fourteen projects are described briefly: funding, description, status, history, and progress in the current quarter. (LTN)

28312 (DOE/PC/20041—T1) **Development and application of analytical techniques to chemistry of donor solvent liquefaction. Quarterly progress report, January-March 1980.** Dorn, H.C.; Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jun 1980. Contract AC22-80PC20041. 20p. NTIS, PC A02/MF A01.

Elemental analyses (Mg, Al, P, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Zr, Mo, Cd, Ba, W, Hg) employing ICP-OES have been measured on ashed samples of Amax feed coal and Amax SRC. Significant concentrations of most of the elements monitored were found. Since the SRC process is designed to remove mineral matter it is not surprising that the level of metal in SRC is lower than in the feed coal for many metals. Unexpectedly certain elements appear to be concentrated into the SRC product. Those metals where the concentration has diminished greatly (Ca, Al, Fe and Mg) on going from raw coal to SRC are probably mineral related. As Figure 2 attests there are numerous metals (Co, Zn, Cu, Ni, Cr, Mn, Cd) whose concentration is higher in SRC. These, we believe, are most likely organic related in SRC. This is not unreasonable since the group is 100% transition metals and it is these metals which are most likely to form organometallic species. Cobalt and zinc are especially noteworthy in this regard showing a threefold increase in concentration in SRC over the feedstock. The classical method for subdividing a coal liquid via selective solubility into oils, asphaltenes, and asphaltols (pre-asphaltenes) followed by ashing of these Amax SRC derived samples and ICP analysis has been accomplished. The data shown graphically in Figure 3 and in Table 4 indicate appreciable concentrations of metal in all three fractions.

28313 (EPRI-AF—1287) **Solvent-refined coal (SRC) process operation of solvent-refined coal pilot plant at Wilsonville, Alabama. Annual report, December 1979.** Lewis, H.E.; Weber, W.H.; Usnick, G.B.; Hollenack, W.R.; Blair, H.O.; Boykin, R.G. (Catalytic, Inc., Wilsonville, AL (USA)). Dec 1979. Contract EX-76-C-01-2270. 227p. NTIS, PC A11/MF A01.

Operating conditions and test results obtained at the six-ton-per-day solvent refined coal (SRC) pilot plant in Wilsonville, Alabama, are summarized. Two coals were processed. The effects of process variables on SRC yield and solvent quality were investigated. These variables included space rate, coal mineral concentration in the dissolver, hydrogen partial pressure, and temperature. A system for continuously withdrawing a portion of the dissolver contents was operated to investigate the effects of minimizing the concentration of solids in the dissolver. Tests confirming the high rate of coal conversion at short residence time were completed. Several methods of deashing the low pressure reaction product were tested: pressure-leaf filtration, centrifugation with antisolvent addition, and 10 mm hydroclones with antisolvent addition. Both horizontal and vertical pressure-leaf filtration units were tested. Filter aids such as perlite, fly ash, and several grades of diatomite were used. Operating without precoat was also studied. A proprietary method of deashing liquid SRC was also tested. The system (developed by Kerr-McGee Corporation) employs an extraction technique in conjunction with a proprietary solvent which operates near critical conditions. The effect of SRC process conditions and CSD operating conditions on SRC recovery was studied. Several tests were also made to optimize the conditions for recovering process solvent containing light SRC.

28314 (FE—2034-18) **Catalytic hydrogenation of coal-derived liquids.** Berg, L.; McCandless, F.P. (Montana State Univ., Bozeman (USA)). 28 Mar 1980. Contract AC01-76ET10495. 30p. NTIS, PC A03/MF A01.

It is the objective of this research to convert coal to clean distillate fuels. This program will be limited to research on the product of PAMCO's solvent refined coal (SRC). The SRC will be heated and pumped, with and without solvent, into a catalytic reactor in the presence of hydrogen and other reducing gases. Variables to be investigated will include temperature, pressure, space velocity, hydrogen-to-oil ratio and chemical nature of the solvent. The catalysts to be studied will include nickel molybdate and sulfide, nickel tungstate and other combinations on carriers such as mordanites and other molecular sieved types. The work on the development of catalysts capable of converting solvent refined coal, SRC-II, into a feedstock suitable for a conventional petroleum refinery was continued. This requires a process which reduces the nitrogen content from the 1.17% in SRC-II to at least as low as 0.3%. Four catalysts were fabricated and evaluated. A cobalt, molybdenum, nickel, tungsten metal loading was made on a molecular sieve base possessing 88.9A average pore diameter. It produced specification product before and after burnoff with air. Three cobalt molybdate catalysts of different metal loadings were fabricated on three different pore diameter bases, 88.9A, 156.5A and 186.2A. Specification grade denitrogenation and regeneration was accomplished although all the results are not yet in. A blank run with no metal loading had no merit as a denitrogenation catalyst.

28315 (FE—2305-30) **Investigation of mechanisms of hydrogen transfer in coal hydrogenation. Phase II annual report, January-December 1978.** Cronauer, D.C.; Ruberto, R.G.; Young, D.C. (Gulf Research and Development Co., Pittsburgh, PA (USA)). May 1979. Contract EX-76-C-01-2305. 110p. NTIS, PC A06/MF A01.

The objective of this study is to develop an understanding of the mechanism of hydrogen transfer to coal and its intermediates during liquefaction. The first 18 month period consisted of experimentation with model compounds and the present period is based upon hydrogen transfer liquefaction of coal asphaltenes. This report is written to summarize the first 12 months of the latter period. It appears that the results of experiments with coal and asphaltenes are consistent with those of the model compounds, and the knowledge of both phases can be combined. Specifically, coal liquefaction consists of the thermal cleavage of bonds followed by the stabilization of the resulting free radicals by (1) abstraction of hydrogen from a donor solvent, (2) reaction with other radicals, or (3) attachment (adduction) with products and/or solvent. Coal primarily cracks in C-C, C-O, or C-S linkages between aromatic type units such that transferred hydrogen exists on carbons α to a aromatic ring. The coal free-radicals abstract hydrogen from any available source such as hydroaromatics, naphthenes, alkyl aromatics and dissolved hydrogen, in roughly that order. Solvent losses through adduction (particularly in poor donors) and isomerization are significant, and presumably will lead to decreased activity or effectiveness of recycled solvents. The use of nmr gives an improved understanding of the mechanism of reactions involved in the liquefaction of coal. In this project, the ^3H nmr results in coal liquefaction are consistent with previous kinetic studies on model compounds with deuterium scrambling superimposed.

28316 (FE—2306-32) **Research and development of an advanced process for the converson of coal to synthetic gasoline and other distillate fuels. Quarterly technical progress report No. 7, October-**

December 1978. Schneider, A.; Hollstein, E.J.; Janoski, E.J.; Scheibel, E.G. (Suntech, Inc., Marcus Hook, PA (USA). Research and Engineering Div.). Feb 1979. Contract EX-76-C-01-2306. 40p. NTIS, PC A03/MF A01.

We conclude from our present work: (1) Aqueous methanol is a practical solvent for separating the nitrogen and oxygen compounds in the naphtha and middle distillate boiling ranges. (2) Extractive distillation of the naphtha fraction and the 15 wt % lowest boiling fractions of the middle distillate with a high boiling phenolic solvent may be more economic than solvent extraction. (3) The SRC-II heavy distillate, per se, cannot be extracted with aqueous methanol but can be extracted with a dual solvent system. (4) Extraction of coal liquids with DMF may be simpler and more economic than extraction with aqueous methanol. (5) Continuous liquid extraction of coal liquids can be practiced successfully. (6) Extraction of coal liquids with water and with aqueous methanol at superatmospheric temperatures and pressures may be practical.

28317 (FE—2306-35) **Research and development of an advanced process for the conversion of coal to synthetic gasoline and other distillate fuels. Quarterly technical progress report No. 8, January 1979-March 1979.** Schneider, A.; Hollstein, E.J.; Janoski, E.J.; Scheibel, E.G. (Suntech, Inc., Marcus Hook, PA (USA). Research and Engineering Div.). May 1979. Contract EX-76-C-01-2306. 47p. NTIS, PC A03/MF A01.

We conclude from our present work that: (1) Continuous deep liquid extraction of coal liquids with DMF-heptane is entirely feasible. The use of DMF-heptane is more practical than aqueous methanol. (2) With the DMF-heptane system, the extraction can be tailored to remove any desired amount of coal liquids. (3) The extraction procedure as practiced with either DMF or aqueous methanol does not remove all basic nitrogenous material but successfully removes the phenolic material. (4) Attempts to hydrorefine the highly phenolic extract product cause the evolution of much methane at relatively low temperatures. (5) Catalytic hydrodenitrogenation and hydrodeoxygenation follows first order kinetics.

28318 (FE—2595-5) **Development of new catalysts for coal liquids refining. Fifth quarterly report, 1 January 1980-31 March 1980.** (Filtrol Corp., Los Angeles, CA (USA)). Apr 1980. Contract AC01-78ET12103. 28p. NTIS, PC A03/MF A01.

The first series of cracking catalysts formulated with 20% exchanged Na-Y zeolite, and 80% matrix binder was activity tested with a hydrotreating SRC-II Fuel Oil Blend. The best results, 47.8 wt % corrected conversion at 900°F and 60.9 wt % corrected conversion at 1000°F, and 37.8 wt % and 43.4 wt % C_5-EP gasoline yields respectively, were obtained with a rare earth exchanged zeolite. An improved catalyst for hydrotreating SRC-II Fuel Oil Blend was prepared from a nickel molybdate impregnated Kaiser alumina support promoted with P_2O_5. The observed hydrodenitrogenation was 85%, and desulfurization was 96% after 24 hours on stream at 750°F; 1000 psig; 1ml/ml-hr, LHSV; and 5000 SCF/bbl., H_2 flow rate. Synthesis and characterization of various catalytic components and cation exchange of these materials is essentially complete. Exploratory cracking, hydrocracking, and hydrotreating catalysts are being produced in preparation for activity testing.

28319 (GFETC/IC—79/1, pp 157-169) **Performance of low rank coals in the Exxon donor solvent process.** Mitchell, W.N.; Trachte, K.L.; Zaczepinski, S. (Exxon Research and Engineering Co., Baytown, TX). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The Exxon Donor Solvent Coal Liquefaction Process (EDS) handles a full range of coals ranging from bituminous through subbituminous to lignites. The overall process performance based on the 50 lb/day recycle coal liquefaction unit (RCLU), and the 1 ton/day coal liquefaction pilot plant (CLPP) is summarized as a function of process conditions and coal rank. Special emphasis is placed on the conversion and yield response of the range of coals demonstrated in the EDS process. In addition to the liquefaction potential, the operability issues associated with operating on low rank coals are addressed. More specifically, the relationship between the operating severity and the liquefaction bottoms viscosity is explored in detail. Also, the calcium carbonate scale deposition and agglomerate formation in the process reactors are covered. As part of this discussion, process and mechanical solutions to this problem are summarized.

28320 (GFETC/IC—79/1, pp 170-206) **Application of liquefaction processes to low-rank coals.** Willson, W.G. (Dept. of Energy, Grand Forks, ND); Knudson, C.L.; Baker, G.G.; Owens, T.C.; Severson, D.E. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The effects of the unique properties of low-rank coal are not well enough defined to permit direct application of liquefaction processes developed for bituminous coals. Chemical and engineering data bases are necessary before techniques applicable to SRC II, H-coal and Donor Solvent processes could be applied to lignites and subbituminous coals. Previous work at GFETC and UND is briefly reviewed, and results from this and current programs are presented. Emphasis has been on production of distillable liquids from reaction of lignite with synthesis gas ($CO + H_2$) in a hydrogen donor solvent. Tests in a 5-lb/h continuous process unit at elevated temperatures using a stirred-tank reactor showed that the molecular weight of soluble but nondistillable product fraction was lower at higher reaction temperatures, although this effect was not as pronounced as in a batch autoclave. In hot- and cold- charged batch autoclave tests, reaction rates and product distributions were investigated using several solvents. Two solvents were selected for use in planned tests to determine the cataytic effects of diverse mineral matter in 8 different low-rank coals.

28321 (SAND—80-0123) **Catalyst characterization in coal liquefaction. Annual report, October 1, 1978-September 30, 1979.** Thomas, M.G.; Sample, D.G. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01.

Neutron activation of American Cyanamid 1442A CoMo catalyst was employed to tag a one-day's charge of catalyst in H-Coal PDU run no. 9. The activity of ^{60}Co in the withdrawals has shown that ~ 8 days are required to uniformly distribute a daily addition of catalyst in the bed during PDU run no. 9 (i.e., the activity reached a maximum approximately eight days after insertion). Catalysts used in the LC-Fining of SRC-I show aging characteristics similar to H-Coal catalyst: 20 to 30 w/o organic contamination, 2 to 5 w/o inorganic contamination, 50% loss of surface area, and changes in pore volume distributions. Elemental distribution of contaminants indicate that the catalysts are extremely efficient metals scavengers, with titanium and iron major contaminants penetrating ~ 200 μm into the catalysts. A mechanistic pathway for coal liquefaction has been experimentally verified by the combination of low temperature (25 to 300°C) batch reaction data in inert atmospheres, high temperature-moderate pressure reaction data (500 psi H_2) from tubing reactors at 400 and 425°C, and high pressure (2000 psi H_2) data collected in a continuous reactor at 400°, 425°, and 450°C. The pathway identified solvent as a reactant with coal, but there was no dependence on H_2 gas for these reactions. Subsequent reactions are influenced by H_2 and catalysts such as FeS_2 and commercially available CoMo. Comparisons are necessarily made at constant conversion to elicit catalyst selectivity. Rates of non-catalyzed reactions at benzene conversion of 60% or less, are shown to be influenced by temperatures between 400 and 450°C, while product distributions are not.

28322 **Evaluation of 2-1/4Cr-1 Mo steel for coal liquefiers.** Woods, C.M.; Scott, T.E. (Ames Lab., IA). *Mater. Compon. Newsl.;* No. 26, 6-8(1 Feb 1980).

The anticipated conditions in a coal liquefaction dissolver vessel include temperatures in the range 500 to 850 F with hydrogen pressures from perhaps 1000 psi to possibly 4000 psi. In many respects, coal liquefaction is similar to petroleum refining and much technology from the latter can be adapted to coal liquefaction. However, caution must be exercised because, depending on the particular coal, the sulfur content of coal derived liquids often is higher than in crude oil; also, the chlorine content of coals can be relatively high. Since commercial dissolver vessels are expected to be large, their failure would cause extended and extremely costly plant shutdowns. Consequently, serious efforts must be made to assure long (10 to 30 years) operating life reliability of dissolver vessels if coal derived liquid fuel is to become economically viable. In view of the importance attached to reliability of dissolver vessels and because there are large uncertainties involved in a one-to-one transfer of refinery technology to coal liquefaction, a careful evaluation of potential dissolver vessel materials has been initiated under DOE sponsorship at the Ames Laboratory of Iowa State University in Ames, Iowa. The material selected for the first round of studies was 2-1/4Cr-1Mo steel. This steel was used to construct the dissolver vessel for the Solvent Refined Coal (SRC) demonstration plant operated by the Pittsburgh and Midway Company at Ft. Lewis, Washington. In addition, samples of this alloy were exposed to simulated dissolver environments and these results are reported here. (LTN)

28323 **Coal liquefaction program at the US Department of Energy.** Lacey, J.J. (Pittsburgh Energy Tech. Center, PA). *Trans. Am. Nucl. Soc.;* **33**: 14-15(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28324 **Department of Energy coal conversion demonstration plant program.** Joseph, L.M. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **33**: 16(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

PYROLYSIS AND CRACKING

28325 (FE—3167-T9) **Investigation of the devolatilization of coal under combustion conditions. Sixth quarterly report, 1 January 1980-31 March 1980.** Seery, D.J. (United Technologies Research Center, East Hartford, CT (USA)). Apr 1980. Contract ET-78-C-01-3167. 33p. NTIS, PC A03/MF A01.

This report describes progress in a study of the pyrolysis of coal under combustion conditions. Major accomplishments have been the initial analysis of the devolatilization data taken with the isothermal furnace reactor and characterization of a new bituminous coal whose behavior with respect to tar release varies significantly from previous bituminous coals examined. Work is continuing on the organic oxygen analysis of coals and chars and the calibration of the furnace for the various pyrolysis gas species as well as NO.

28326 (LA-UR—80-1094) **Flash pyrolysis and gasification of coal through laser heating.** Beattie, W.H.; Sullivan, J.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800806—28). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

Experimental results obtained from the rapid pyrolysis of finely powdered coal are presented. The experiments are designed to provide basic information on gas yield, gas composition, optimum fluxes, and temperature history of coal samples under high intensity laser radiation. The information obtained from these experiments will be used to test concepts for the use of concentrated sunlight to produce fuel gases from coal. Heating the coal at rates of 10^3 to 10^4 C/s in an inert atmosphere of argon results in pyrolysis at temperatures between 400 and 800°C. The gases evolved are primarily CO, H_2, and CH_4 with lesser amounts of CO_2 and other light hydrocarbons. Mass spectrometry is used to determine the composition of the evolved gases. The optimum flux for laser pyrolysis of coal was found to be 250 W/cm^2. Results from experiments wherein the char created by pyrolysis is gasified to CO in an atmosphere of CO_2 are also presented.

BY-PRODUCTS

28327 (BCRA—70) **Low-temperature tar content of bituminous materials. Part 1. Dense tar surfacing with crushed rock aggregate.** (British Carbonization Research Association, Chesterfield). Jul 1979. 14p. NTIS, PC A02/MF A01.

The limited study using the two crushed rock aggregates with high- and low-density tars of coke-oven and low-temperature carbonization sources has shown that equal volumes of tar are required, regardless of carbonization source. It is recommended that, when the density of the tar is below 1.12 g/ml, an additional reduction in tar content of 0.3% by mass should be applied to the recommendations in the British Standard.

PROPERTIES

REFER ALSO TO CITATION(S) 28292, 28293, 28298, 28312, 28338, 28343, 28360, 28361, 28364, 28908, 28909, 28915

28328 (LA-UR—80-586) **New improved standard for electron probe determination of organic sulfur in fossil fuels.** Harris, L.A.; Raymond, R. Jr.; Gooley, R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800815—1). NTIS, PC A02/MF A01.

From Microprobe Analytical Society conference; San Francisco, CA, USA (Aug 1980).

This paper reports on petroleum coke that is stable under an electron beam and contains a uniform sulfur content. Hence, it is a suitable standard for analysis of organic sulfur content of coal. It should be as applicable for analysis of organic sulfur in other fossil fuels. This standard is available for distribution.

28329 (METC/SP—79/10(Pt.1), pp 215-219) **Proposal for classification of fly ashes.** Kocuvan, I. (Salonit Anhovo Co., Anhovo, Yugoslavia). 1979.

From 5. international ash utilization symposium; Atlanta, GA, USA (25 Feb 1979).

The described classification system for the fineness and composition of fly ashes was found useful to compare ashes of different origin and also ashes from the same coal burned in different boilers. It will be desirable if this or a similar system is adopted for universal use that would facilitate the exchange of information and contribute to the solution of the problems of fly ash utilization.

28330 (UCRL—84366) **Use of an automated mass spectrometer for an underground coal gasification field test.** Crawford, R.W.; Bedford, R.G.; Wong, C.M.; Brand, H.R.; Kishiyama, K.I. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1980. Contract W-7405-ENG-48. 27p. (CONF-800732—1). NTIS, PC A03/MF A01.

From International dynamic mass spectrometry symposium; Centerbury, UK (7 Jul 1980).

A time-of-flight mass spectrometer was successfully used to analyze the product gas from an underground coal gasification field experiment. It proved to be precise and moderately accurate. It was extremely stable and reliable. Its speed was more than adequate for most requirements. A series of changes will be made to improve accuracy and detection limit. The analysis of product gas was fully automated, but any other operation took manual intervention. We plan to upgrade the interface between the valves on the inlet system and the computer to allow reliable automatic operation. This will allow computer controlled reading of background and spectral calibration with pure gases, and quality assurance testing with a known gas mixture. Finally, we intend to increase sensitivity by installing an electrometer with computer selectable gain. This should allow us to quantify components such as argon down to 0.01% levels.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 28366, 28908, 28911, 29629, 29707

28331 (EPRI-CS—1376) **Coal mine disposal of flue gas cleaning wastes. Final report.** Duvel, W.A. Jr.; Call, P.; Buckley, B.; Moore, R. (Environmental Research and Technology, Inc., Concord, MA (USA)). Jun 1980. 166p. NTIS, PC A08/MF A01.

This report summarizes the state-of-the-art of disposal of electric utility flue gas cleaning (FGC) wastes, defined as fly ash and flue gas desulfurization (FGD) wastes, in active and abandoned mines; presents six examples of full-scale mine disposal operations; examines the regulations promulgated under the Surface Mining Control and Reclamation Act of 1977 (SMCRA); identifies the anticipated effects of the regulations on mine disposal operations; and outlines areas of additional research. Underground mine disposal of FGC wastes is not well developed. There is only one full-scale fly ash disposal operation and no experience with FGD sludge disposal. In surface mines, both pit bottom disposal and vee disposal have been demonstrated to be practical disposal alternatives that can be integrated with the active mining operation. Disposal in abandoned surface mines is being conducted at several locations in a manner similar to conventional landfills. The SMCRA regulations do not specifically address FGC waste disposal, except to a very limited extent. The regulations are open to considerable interpretation and, if rigorously applied, could severely constrain or limit mine disposal alternatives.

28332 (EPRI-EA—1377) **Organic material emissions from holding ponds at coal-fired power generation facilities. Final report.** Rosecrance, A.E.; Colby, B.N. (Systems, Science and Software, San Diego, CA (USA)). Mar 1980. 80p. NTIS, PC A05/MF A01.

A literature survey of organic chemical emissions from holding or ash ponds which are used by most coal-fired utilities to collect process waste materials has been conducted. Only a small quantity of compound-specific information was available concerning surface runoff and none was available for groundwater seepage or atmospheric emissions. Approximately 140 Kg/day of organic material is predicted to be present in surface runoff of a hypothetical 1000 MW facility of which only 3.5 Kg/day, or 2.6% of the total, is accounted for by specific compounds. Of the compounds identified, only phenol is near a level (97 μg/l) of potential environmental significance. Due to the lack of information describing holding pond emissions, a survey of known holding pond influents was undertaken to assess which processes were most likely to be associated with the organic chemical content of the pond. Of the process wastes directed into the pond, cooling tower blowdown, water treatment wastes and boiler blowdown are identified as the major contributors of organic material. Organic chemical additives, which are used to control bacterial buildup, scale formation, pitting, corrosion, pH stability, and solid dispersion, account for approximately 96% of the organic pond influents. The majority of these materials do not represent an environmental hazard; however, they may undergo chemical reactions in the pond which increase their environmental significance.

28333 (FE—3269-8A) **Design, construction, operation and evaluation of a prototype culm combustion boiler/heater unit. Technical progress report, January 1, 1979-March 31, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Apr 1979. Contract ET-78-C-01-3269. 37p. NTIS, PC A03/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis during the period January 1, 1979 through March 31, 1979. The objectives of the program as well as the technical progress and problem areas encountered during the reporting period are presented. Progress on the components and

system engineering studies is described. Results of the combustion of anthracite culm is a fluidized bed are presented. Environmental investigation in the area of air quality, noise and liquid and solid waste effluent disposal is described herein.

28334 (GFETC/IC—79/1, pp 117-146) **Power plant flue gas desulfurization for low-rank western coals.** Ness, H.M. (Dept. of Energy, Grand Forks, ND); Selle, S.J.; Manz, O.E. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The technology most widely used for SO_2 removal is the lime/limestone wet scrubber process, with over 60,000 MW of capacity installed, under construction, or being considered. Approximately 6000 MW of this capacity is for Western generating units to utilize fly ash or fly ash supplemented with additional alkali. The status of ash-alkali wet scrubbing installations are reviewed, and operational factors, calcium availability, power requirements, waste disposal, and economics are discussed. Spray driers and dry sorbent desulfurization processes are evaluated on the basis of advantages and process-operational parameters. A field scale study of fly-ash-alkali sludge disposal is reported.

28335 **Hot gas cleanup by a confined-vortex scrubber.** Shui, V.H.; Stickler, D.B.; Clark, S.W.; Tong, K.O. Everett, MA; Avco Everett Research Laboratory, Inc. (1980). 55p. (NP—24975).

This hot gas cleanup process uses a reactive liquid confined centrifugally in a cylindrical vortex chamber, driven by the gas flow. Liquid confinement is on the large physical scale of the stationary vortex chamber while gas-liquid transport interaction occurs on a small bubble-dominated scale in the two-phase wall shear flow. This results in efficient capture of both gaseous and small particulate contaminants by the recycled liquid. Important features, operating parameters, and some experimental data will be discussed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 28290, 28301, 28377, 28517, 28928, 28929, 29580, 29592, 29597

28336 (DOE/ET/13060—25(Vol.4)) **Phase I: the Pipeline Gas Demonstration Plant. Environmental report. Volume 4. Environmental data Appendix A.** (Conoco, Inc., Stamford, CT (USA)). Jan 1980. Contract AC01-77ET13060. 305p. NTIS, PC A14/MF A01.

The purpose of this study is to determine whether adequate water is available for the PGDP from Noble County and the surrounding area. Raw water sources in and near Noble County, Ohio that were reviewed are: (1) local groundwater, (2) Little Muskingum River, (3) Muskingum River, (4) Ohio River, and (5) Senecaville Reservoir. Poor reliability and/or expected pipeline routing difficulties and extensive costs were limiting factors for all but Senecaville Reservoir. Sale of water from Senecaville Reservoir is controlled by the Muskingum Watershed Conservancy District (MWCD). Evaluation of Senecaville Reservoir as a suitable water source for the PGDP was based on determining whether diversion for the PGDP would place a substantial burden on the reservoir and whether the quality of water is adequate for the PGDP. Senecaville Reservoir was found to be the most attractive source of water for the PGDP because of proximity to the site and availability of water. A detailed water budget of the reservoir indicates that ample water is available for the PGDP and that the increased drawdown due to the PGDP will be 0.29 feet on a monthly average basis, during the worst drought expected once every 30 years. If the present approved regulation strategy of Senecaville Reservoir is maintained by the US Army Corps of Engineers, withdrawals by the PGDP will not appreciably impact any of the intended uses of the reservoir. It is unlikely that the PGDP will have a noticeable effect on the users of the reservoir.

28337 (DOE/ET/13557—12) **SRC liquid spill episode, SRC Pilot Plant, Ft. Lewis, Washington. Intermediate report: site visit observations and findings, January 29-February 20, 1980.** Meyer, A.F. Jr. (Meyer (A.F.) and Associates, Inc., McLean, VA (USA)). 27 Feb 1980. Contract AC02-79ET13557. 37p. NTIS, PC A03/MF A01.

This report is intended to provide responsible DOE authorities with the professional observations and recommendations resulting from this firm's technical assistance in evaluating an accidental release of solvent refined coal (SRC) processed liquids at the SRC Pilot Plant, Ft. Lewis, Washington. The spill occurred during the night of December 19-20, 1979 at the facility operated for DOE by the Pittsburgh and Midway Coal Mining Company. The site visit on January 29, 1980 was made by DOE's staff member, Mr. John Abrahams, and this firm's representative, Mr. ALvin F. Meyer, Jr., P.E., President. In brief, the spill of approximately 2300 gallons of SRC processed liquids was caused by human failure. Compounding the circumstances was the presence of a bleeder valve which was inexplicably left open. Additional factors contributing to the episode were the fact that the operation was conducted at night, and the presence of steam and noise which obscured, at least partially, the possibility of detecting the spill occurrence. After operating personnel discovered the spill, the plant management of Pittsburg and Midway Coal Mining Company were informed. It was decided that environmental surveys and measurements would be undertaken to detect any possible contamination. Subsequent to the site visit, additional information was provided by Pittsburg and Midway Coal Mining Company, and by Hqs. ASFE Program officials. Analysis of the available data to date (February 22, 1980) indicates that no off site (SRC Plant boundaries) environmental contamination has occurred. A need exists for close further study and evaluation.

28338 (GFETC/IC—79/1, pp 496-537) **Energy effects on air quality.** Christianson, G.A. (North Dakota State Department of Health, Bismarck). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

North Dakota was one of the first states to adopt a Prevention of Significant Deterioration (PSD) regulation. In May of 1977, EPA delegated responsibility for PSD to the state, which included a more stringent definition of Best Available Control Technology (BACT). Class I areas are subject to the most stringent restraints on air quality. In Western North Dakota, Class I areas include the Theodore Roosevelt National Park (TRNP) and the Lostwood National Wildlife Refuge (total area 75,300 acres). Protection of air quality within these areas is a major factor in siting of energy development projects. Computer dispersion modeling analysis indicated that the controlling factor for PSD is the 24-hour maximum allowable increment for SO_2. Combined SO_2 emissions as initially estimated from Coal Creek, Coyote No. 1, American Natural Gas, and Antelope Valley Units No. 1 and 2 projects would use the allowable increment of 5 $\mu g/m^3$. If sour natural gas continues to be found around the TRNP, allowable increments possibly available for future coal developments may be consumed before Permit to Construct applications are filed. Effects of emissions on humans, animals and the general environment are reviewed with the conclusion that the energy projects discussed are not expected to have perceptible adverse effects.

28339 **Coal slurry observed as habitat for semiaquatic beetle Lanternarius brunneus (Coleoptera: Heteroceridae), with notes on water quality conditions.** Vinikour, W.S. (Argonne National Lab., IL). *Entomol. News;* **90**: No. 4, 203-204(Oct 1979).

The variegated beetle, Lanternarius brunneus (Melsh.), was found inhabiting a slurry area at an orphaned coal mine site in Illinois. Water quality analyses indicated the beetle lived in coal fines and mud saturated with water indicative of acid mine drainage i.e., pH < 4.0 and elevated sulfate and heavy metal concentrations. This is the first report of Heteroceridae occurring in this type of habitat and in conditions normally toxic to other aquatic or semiaquatic insects.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 28298, 28354, 28360, 28909

28340 (GFETC/IC—79/1) **Technology and use of lignite.** Kube, W.R.; Gronhovd, G.H. (comps.). (Department of Energy, Grand Forks, ND (USA). Grand Forks Energy Technology Center). 1979. 542p. (CONF-790579—). NTIS, PC A23/MF A01.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The symposium on the technology and use of lignite was sponsored by the US Department of Energy and the University of North Dakota, and held at Grand Forks, North Dakota, May 30-31, 1979. Twenty-one papers from the proceedings of this tenth biennial lignite symposium have been entered into EDB and ERA and three also into EAPA. The papers discuss lignite deposits in the USA, mining plans, gasification and in-situ gasification, and combustion in fossil-fuel power plants. (LTN)

28341 (GFETC/IC—79/1, pp 357-387) **Potential for utilization of resources from the Hat Creek coal deposits.** Goldie, H.J.; McCullough, P.T.; Papic, M.M. (British Columbia Hydro and Power Authority, Vancouver). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Coal deposits of the upper Hat Creek Valley lie in the Interior Plateau of British Columbia, northeast of Vancouver, and are of subbituminous C rank by the ASTM classification. These coals have highly variable chemical and chemical properties. Two deposits contain over 2.2 billion tons of coal. True thickness in Deposit 2 is as great as 240 ft without significant repetition. A 2000-MW thermal powerplant has been proposed to utilize one of the deposits. Geology of the deposits proposed mining plan, and properties of the coal are described. Potential by-products from mining, beneficiation, powerplant operation, and other processing and their properties are

presented. Processing other than electrical generation and possible utilization of by-products were evaluated. Seven potential uses of the coal were considered technically feasible. Of these, only electric power has assured markets. Others were uneconomic or face uncertain markets. Use of by-products is limited by distance from markets and/or lack of cheap transportation.

28342 (GFETC/IC—79/1, pp 426-458) **Future of Texas lignite.** Lacy, J.C. (Radian Corp., Austin, TX); White, D.M. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Strippable deposits are close to the two major metropolitan areas, making lignite an attractive potential fuel for electrical generation and for industrial use. Lignite is perceived by policymakers and the public as a transition fuel for use between depletion of oil and gas reserves and commercialization of renewable energy sources. Main economic and regulatory forces are systematically examined to develop growth estimates. Various alternates in sources of energy, regulatory requirements, and uses are reviewed. For the nominal case scenario, a tenfold increase in production by 2000 AD to approximately 200 mty was forecast, which implied a commitment of 6.0 billion tons of the estimated 6.7 billion ton reserve. Other scenarios are developed and key policy issues reviewed.

28343 **Reconnaissance survey of the petrology of New Zealand coals with recommendations as to their utilisation.** Black, P.M. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1980). 50p. (NZERDC—51).

New Zealand coals have the petrographic properties typical of many young coals: i.e., strongly detrital nature, high vitrinite (huminite) and very low inertinite contents in comparison with the older Carboniferous and Gondwana (Permian-Mesozoic) coals which have high inertinite content including an abundance of fusinite. It is the high vitrinite content of the New Zealand coals which gives them their very high reactivity and swelling capacity in comparison with Carboniferous (North American and European) and Gondwana (Australian, Indian, and South African) coals. New Zealand lignites can be compared with lignites and brown coals from elsewhere in the world since most of these coal types are Tertiary in age. Higher rank New Zealand coals have, under the microscope, the morphological appearance and contain some of the macerals characteristic of brown coals, but the rank (reflectance) of hard coals. Tertiary coals of bituminous rank are not common. Elsewhere they occur in active geological environments similar to that of New Zealand (e.g., Japan, Columbia). High rank Tertiary coals do not occur in stable continental environments (unless the high rank is a result of igneous intrusion) and these coals should not be compared to the Carboniferous and Gondwana coals of similar rank.

MINING

REFER ALSO TO CITATION(S) 28342, 28375, 28377, 29294, 29463

28344 (BMFT-FB-HA—80-010) **Improvement of industrial safety by monitoring stress which may result from rock bursts and by registering seismic events.** Baule, H.; Will, M. (Ruhrkohle A.G., Essen (Germany, F.R.)). Jun 1980. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01.

Above and below ground measuring systems were developed for registration of seismic events caused by stress changes in coal and rock. The mobile above ground station registered 34 seismic events during one year. The epicenters of these events could be evaluated. With 2 underground missions in extraction areas, the seismoacoustic system registered 10,000 resp. 12,000 events during 4, resp. 3 months periods. Localization methods and statistical programs were developed for data analysis. The most important result found by the application of these methods is a narrow zone of seismic sources normally situated 20 to 30 m in front of the long wall face. Further development of the seismoacoustic system seems possible in order to get a continuous control of endangered areas.

28345 (BMFT-FB-HA—80-011) **Development of mine fire and explosion protection equipment for dry dust-extractors.** Auberg, H.; Scholl, E.W.; Faber, M. (Ruhrkohle A.G., Essen (Germany, F.R.)). Jun 1980. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01.

Large-scale dry dust-extractors are used underground in coal mines at central points with high dust concentrations in order to clean the dust-laden air. Several mine fires have occurred in such dust-extractors. To reduce the hazard of fire, special equipment, instruments and methods suitable for early detection and suppression of mine fires by automatic fire extinguishers have been tested in a dust extracting unit installed on the surface at the experimental mine road of the Westfaelische Berggewerkschaftskasse. Parallel test series in two large-scale dry dust-extractors underground showed that the methods and equipment developed for test dust-extractors were ready for application in practice. The measures proposed will help to improve the protection against mine fires and explosions in large-scale dry dust-extractors.

28346 (BMFT-FB-HA—80-012) **Ergonomic design of mining machines and equipment.** Hamm, E. (Ruhrkohle A.G., Essen (Germany, F.R.)). Jun 1980. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01.

The present level and future priorities of the ergonomic working procedure at Ruhrkohle AG were laid down in an expert's report. Three prototypes were developed and tested for a period of 12 months for the ergonomic design of side discharging and dinting loaders to be used underground. The results show that the strains and stresses on the operators were reduced by this working concept especially in the area of one-sided dynamic work, static posture work and static control of the machinery levels. The stress due to the noise was reduced, too. The strain placed on the heart-circulatory system as well as the strain on the muscles examined was significantly reduced in spite of the increased efficiency achieved when using the prototypes. This is the result of the reduced energy required to operate the machine, the shorter distances travelled to operate it, more favourable channelling of the operator's energy and the point of attack at the elements are operated leads to more favourable energy consumption. In addition the mechanical vibrations were also reduced. An ergonomic guide-lines manual for the future manufacture in series and the general overhauling of side discharging and dinting loaders is enclosed.

28347 (BMFT-FB-HA—80-013) **Dust suppression with shield and powered supports.** Hamm, E. (Ruhrkohle A.G., Essen (Germany, F.R.)). Jun 1980. 202p. (In German). NTIS (US Sales Only), PC A10/MF A01.

The introduction of shield supports early in the seventies caused, in addition to advantages concerning safety and the effectiveness of supports, also an increased dust development in the face. Within the above project, it was tried to develop measures to reach a reduction of dust development by 50%. As such measures, water spraying, dust extraction and sealing of gaps between the individual shield units were tried. Different geological conditions and different types of support were included in the investigations. In the majority of the eleven investigated coal faces, the aim of the reduced dust development was reached by water spraying. Installations ready for application in practice were developed. Dust exhaustion requires intensive fundamental investigations before being tried in practice. The Technical University of Clausthal will continue to deal with this part of the project. No suitable material could be found so far for the sealing of gaps between the individual shield units. It is recommended that dry dust suppression methods be developed, as present measures of wet dust suppression have disadvantages.

28348 (BMFT-FB-HA—80-014) **Integrated dust suppression.** Kopper, W. (Ruhrkohle A.G., Essen (Germany, F.R.)). Jun 1980. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01.

In the course of this project, different measures of dust suppression were studied with regard to their effectiveness in the sectors of coal winning, stowing and belt conveying. The investigations served the following purposes: the optimum interplay of different measures in and near coal faces, and possibilities for reducing dust development in large belt conveyor installations. In the working districts, the methods wre applied, e.g. water infusion from the coal face and from the gateroads, water spraying on the track of the coal ploughs and over the caved debris; all these processes being tried with and without an addition of $CaCl_2$ to the water. The results of measurements showed the best values for the series of tests, Water Infusion and Water Spraying in Track of the Coal Plough with Addition of $CaCl_2$. An improvement of the dust conditions was reached in belt conveying by cleaning the bottom strand of the belt conveyor from sticking material by means of a brush as well as by a surface treatment of the conveyed material by water with $CaCl_2$. These improvements caused a reduction of the dust concentrations in the fresh air supplied to coal faces.

28349 (DOE/CMTC/TR—80/2) **Vertical borehole design and completion practices used to remove methane gas from mineable coalbeds.** Lambert, S.W.; Trevits, M.A.; Steidl, P.F. (Department of Energy, Carbondale, IL (USA). Carbondale Mining Technology Center; Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Mining and Safety Research Center). Aug 1980. 171p. NTIS, PC A08/MF A01.

Coalbed gas drainage from the surface in advance of mining has long been the goal of researchers in mine safety. Bureau of Mines efforts to achieve this goal started about 1965 with the initiation of an applied research program designed to test drilling, completion, and production techniques for vertical boreholes. Under this program, over 100 boreholes were completed in 16 different coalbeds. The field methods derived from these tests, together with a basic understanding of the coalbed reservoir, represent an available technology applicable to any gas drainage program whether designed primarily for mine safety or for gas recovery, or both.

28350 (FE—8914-2) **Rock detection/destruction concept evaluation study. Final report.** Lichty, J.E.; Shrader, W.D.; Loy, M.D. (Skelly and Loy, Harrisburg, PA (USA)). Feb 1979. Contract ET-77-C-01-8914-002. 141p. NTIS, PC A07/MF A01.

This report examines the potential methods for detection and destruction of rocks in the soft overburden in the glaciated portion of the Fort Union Coal Region. The concepts are designed to work in conjunction with bucket wheel excavators. Detection methods are conceptualized for pre-mining examination and for detection during excavation. Destruction concepts are developed to operate concurrently with the excavators. The concepts are analyzed for technical and economic feasibility.

28351 (FE—8914-4) **Sensitivity analysis and mid-west conveyor application study. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Feb 1979. Contract ET-77-C-01-8914-004. 157p. NTIS, PC A08/MF A01.

This report summarizes findings of a twofold objective. Initially, three conveyor assisted mining systems, developed under DOE Contract Number ET-75-C-01-9022, were subjected to thorough analyses for determining risk and uncertainty of a project. The Dragline, Mountaintop, and Low Wall Conveyor Systems were evaluated utilizing sensitivity, risk, and worst case analyses. The second objective of this study was to determine the feasibility of a Dragline/Conveyor Mining Approach in the midwestern coal fields. In this age of advancing technology, successful managers must make informed investment decisions that determine the future success of their companies. In evaluating projects, every manager is painfully aware that he cannot and will not always be right. Management pressure is increased by the knowledge that a company's future depends on the ability to choose, with a high degree of consistency, those investment opportunities that have a high probability of success. The tools that enable management to make correct decisions are sensitivity, risk, and worst case analyses. Together, these evaluations can quantify the relative risk and uncertainty involved in implementation of new projects. These analyses were applied to the Dragline, Mountaintop, and Low Wall Conveyor systems for a thorough evaluation. Sensitivity analysis of operating cost per ton with respect to certain variable parameters in all three systems was derived by graphical interpretation. The results of the comparative evaluations were significant but not susceptible to simple summarization. The dragline/conveyor approach was regarded as worthy of trial in the midwestern coal fields. (LTN)

28352 (FE—8914-5) **Constraints limiting the availability of front-end loaders. Final report.** Garrett, R.H.; Durborow, S.B.; Young, D.I. Jr. (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-005. 333p. NTIS, PC A15/MF A01.

The ever increasing use of the front-end loader for cyclic operations has created numerous maintenance problems. Loader design requires that during each loading cycle the loader must completely reverse the direction of travel at least three times, necessitating four complete stops and starts. This continuous maneuvering causes fatigue to both machine and operator. The drive train is especially susceptible to torque loads. Engine and hydraulics are subjected to continually varying loads and power requirements causing fatigue and wear. Tires are also vulnerable to damage and wear from constant use. The severity of the overall working environment is the single most determinant factor to loader component longevity. As working conditions become more severe, the failure and wear related downtimes increase dramatically. The most effective way to minimize downtime is to select a loader that incorporates the best available optional equipment to adequately withstand the conditions at the particular site. The front-end loader lacks a mechanical crowding device. This requires the use of tractive forces delivered by the forward motion of the machine. Therefore, the breakout force and crowding action is determined by the tractive ability of the machine which promotes excessive tire wear and places exorbitant strain on the hydraulic and mechanical linkages. Loader weight distribution poses certain problems to tire life. When the bucket is filled and raised, the majority of the weight is on the front wheels. This uneven weight distribution adds considerable rolling resistance to the front wheels which causes increased torque on the drive train and additional stresses in the tire structure.

28353 (FE—8914-6) **Systems analysis of highwall mining systems, extended depth augers. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-006. 148p. NTIS, PC A07/MF A01.

This report is the result of a study conducted from August 1978 to June 1979. The objective of the study is to perform a systems analysis on two competing extended depth auger designs: one designed by R.A. Hanson Company and the other by Southwest Research Institute. Following a brief state of the art review of the auger industry, the designs are compared, and extended depth auger mining is evaluted for two hypothetical sites, one in the Appalachian Coal Region and the other in the Interior Region. Recommendations are presented regarding the better system, potential applications for the auger system, and future research needs.

28354 (FE—8914-7(App.)) **Evaluation of high angle Auger systems. Final report-appendix.** (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-007. 251p. NTIS, PC A12/MF A01.

This report is the result of a study conducted from October 1978 to June 1979. The objective of the study is to quantify and characterize steeply pitching coal reserves and to develop and evaluate high angle augering systems capable of extracting significant amounts of these reserves. The study proposes a concept for a high angle augering system capable of exploiting the vast reserves available on pitches ranging from 25 to 90 degrees.

28355 (FE—8914-7(Vol.1)) **Evaluation of high angle Auger systems. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-007. 88p. NTIS, PC A05/MF A01.

This report is the result of a study conducted from October 1978 to June 1979. The objective of the study is to quantify and characterize steeply pitching coal reserves and to develop and evaluate high angle augering systems capable of extracting significant amounts of these reserves. The study proposes a concept for a high angle augering system capable of exploiting the vast reserves available on pitches ranging from 25 to 90 degrees.

28356 (FE—8914-7(Vol.2)) **Evaluation of high angle Auger systems. Engineering and economic summary evaluation of high angle Auger coal mining systems and equipment.** Wise, J.; Sieg, H.; Shrader, W.D. (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-007. 16p. NTIS, PC A02/MF A01.

This report is the result of a study conducted from October 1978 to June 1979. The objective of the study is to quantify and characterize steeply pitching coal reserves and to develop and evaluate high angle augering systems capable of extracting significant amounts of these reserves. The study proposes a concept for a high angle augering system capable of exploiting the vast reserves available on pitches ranging from 25 to 90 degrees.

28357 (FE—8915(2)-1) **Simulation analysis of improved conventional mining systems. Final technical report.** Brown, G.R.; Schroeder, E.W.; Knoebel, K.Y.; Urie, J.T. (Ketron, Inc., Wayne, PA (USA)). Mar 1979. Contract ET-77-C-01-8915. 90p. NTIS, PC A05/MF A01.

The objective of this project was to determine which of five improved conventional mining machines hold the most promise regarding productivity, costs, and safety. This determination will aid in making decisions of what, if any, further development is needed for improving any of these machines or their related systems. The new machines studied were the: (1) innovative loader; (2) auger cutter with face drills; (3) circular kerf cutter; (4) stretchcar; and (5) coalmaker. Using computer simulation, each machine was analyzed in different system configurations. The results of the simulation indicate a production improvement in the conventional mining systems using stretchcars, the improved loader and the auger cutter with face drills.

28358 (FE—8922-3(Vol.1)) **Development of operational aids for improved dragline utilization: extended bench modification to the dragline computer simulation model. Final technical report.** Keller, K.J.; Thorn, J.S. (McDonnell Douglas Electronics Co., St. Charles, MO (USA)). Apr 1980. Contract AC01-76ET12201. 24p. NTIS, PC A02/MF A01.

The computer simulator model developed under DOE contract ET-76-C-01-8922 was modified to simulate extended bench and pullback procedures. Volume I of this report outlines the modifications made to the simulation model and the results of a simulation study of extended bench and pullback procedures. Volume II is a revision of the system manual for the simulation model.

28359 (FE—8931-T1) **Manufacture and demonstration of sideloader conveyor. Final technical report.** (Joy Mfg. Co., Pittsburgh, PA (USA)). 10 Jun 10080. Contract AC01-76-ET12527. 150p. NTIS, PC A07/MF A01.

This document describes the construction and demonstration of a continuous face haulage system. A laterally-flexible, monorail-mounted, sideloader conveyor was fabricated and installed underground at Mine A-5 of Eastern Coal Corporation, Subsidiary of Pittston Company, near Stone, Kentucky. The 400 foot bendable conveyor was interfaced between a continuous miner and the section panel belt for use in a five entry panel development section. The system operated for thirteen weeks from January 2, 1980 through April 5, 1080. Because of continuing problems with the Sideloader, full production capabilities were never reached. Production and downtime data acquired during the demonstration indicate that the continuous haulage system, while fully capable of carrying the miner output to the section panel belt, was not sufficiently developed to seerve as a production machine. Average shift production during the underground operation was a low 138 tons/shift of raw coal.

28360 (GFETC/IC—79/1, pp 388-425) **Surface mining technology, practices, and plans for Gulf Coast lignite.** Russell, J.E. (Texas A and M Univ., College Station). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Lignite resources of 20 billion tons are estimated for the Gulf Coast Region. Geology of deposits and analyses of the lignites are given. Exploration techniques and leasing practices are reviewed. Necessary mining permits and regulatory agencies are listed for the five Gulf Coast states. In addition, several Federal, state, county and local agencies require permits or notification. These agencies are summarized for Texas. Feasibility studies, mine development, and mining operations are discussed. In 1979, the only operating surface mines were in Texas, with 84% of the total production used in electrical power generation by one utility. Lignite costs were 37.6 cents/10^6 Btu. Other cost estimates (1977 dollars) are over twice as high. Over 20 million tons were mined in 1978, and projections indicate production of 65 million tons in 1985. Productivity is in excess of 70 tons per man-day. Trends indicate deeper mining (~ 250 ft), mining of more multiple seams, increased water problems, larger mines, and higher productivity. Reclamation of mined land is satisfactory. Impact of extensive development on water, air, and socieconomic factors are reviewed.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 28273, 28274, 28275

28361 (DOE/ET/10533—8) **Utilization of coal associated minerals. Quarterly report No. 8, July 1-September 30, 1979.** Slonaker, J.F.; Alderman, J.K.; Buttermore, W.H.; Durham, D.L.; Gierl, D.B.; Grady, W.C.; McMillan, B.G.; Muter, R.B.; Simonyi, T.A. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 31 Mar 1980. Contract AS01-77ET10533. 30p. NTIS, PC A03/MF A01.

Work continued at the Morgantown pilot preparation facility to upgrade system components. The primary focus of this report period, as documented herein, was on the mineralogical quantification/semiquantification of the District 3 Pittsburgh seam coal samples. An in-depth discussion of the combined-techniques-mineralogical-quantification (CTMQ) of major coal-associated minerals in this coal, and a review of how standardized equations and data are derived is discussed in depth. The development of a procedure for the production of aerated concrete was started.

28362 (FE—3242-20) **Laminar flow cyclone development program. Quarterly technical progress report, January 1, 1980-March 31, 1980.** Giles, W.B.; Bekofske, K.L. (General Electric Co., Schenectady, NY (USA). Mechanical Systems and Technology Lab.). Apr 1980. Contract AC21-78ET11031. 23p. NTIS, PC A02/MF A01.

The principal constraint to high Reynolds number operation is due to boundary layer instability in the radial inflow region. Therefore, a modified model has been built to study the influence of inlet wall heating with the water flow model. This wall heated model of the radial inflow region has been adapted with additional thermocouples, plus insulation of the rim. The data continue to indicate highly stable flow conditions up to the maximum test Reynolds numbers. Work is continuing to further increase the system flow rate.

28363 (GFETC/IC—79/1, pp 459-495) **Drying of low-rank coal for MHD applications.** Ziesing, G.F. (Montana College of Mineral Science and Technology, Butte); Forgarrd, K.; LeFever, J.; Rhodes, B.; Griffiths, V. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Cycle efficiency of an MHD generating topping cycle depends on many factors including moisture content of the coal. Modeling studies have indicated that coals with more than 5% moisture will require drying prior to combustion. Rosebud seam coal (23 to 25% moisture) was dried in tests by vendors and in-house studies. Four drying methods were examined - in-mill, indirect, fluid-bed, and spray. Each method was successful in drying Rosebud coal to less than 2% moisture. Moisture-temperature curves are similar for convective dryers. A sharp increase in the in-process temperature observed when coal moisture decreased below 5% corresponds to the onset of a second falling-rate drying period where moisture removal is not dependent upon drying conditions. This observation suggests that drying to low moisture levels might efficiently use a two-stage drying system - a convective dryer followed by a conduction dryer. System analysis indicated that capital costs would not be the controlling factor in equipment selection. Various drying curves and drying efficiencies are presented.

28364 (IS—4738) **Dielectric heating in mixtures containing coal and pyrite.** Fanslow, G.E.; Bluhm, D.D.; Nelson, S.O. (Ames Lab., IA (USA)). Apr 1980. Contract W-7405-ENG-82. 20p. NTIS, PC A02/MF A01.

Run-of-mine (ROM) coal was separated by gravitational techniques into fractions designated as 1.30 float (clean coal) and 2.00 sink (pyrite and ash). Dielectric properties were measured and used to predict heating rates. Predicted values suggested that pyrite and ash would heat from 1.3 to 3.3 times faster than clean coal. Dielectric heating was investigated by heating mixtures containing these two fractions at 2.45 GHz. Results indicated that the pyrite and ash fraction was heated from 1.9 to 2.6 times faster than clean coal.

COMBUSTION

REFER ALSO TO CITATION(S) 28325, 28916, 28928, 28929, 29502, 29509, 29510, 29511, 29512, 29513

28365 (ANL/CEN/FE—78-14) **Process costs and flowsheets, bed defluidization characteristics, stone reactivity changes and attrition losses for a regenerative fluidized-bed combustion process.** Swift, W.M.; Montagna, J.C.; Smith, G.W.; Smyk, E.B. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 104p. NTIS, PC A06/MF A01.

As a means of significantly reducing the amount of limestone required by the fluidized-bed combustion of coal, a limestone regeneration process has been developed which allows the sorbent to be recycled back to the combustor for reuse. To further the development of regeneration, experiments were performed to (1) evaluate the effects of repeated utilization on the sorbent reactivity for sulfation and regeneration and (2) characterize the minimum fluidizing-gas velocity required for the regeneration process to prevent agglomeration and defluidization of the bed. This report presents the results of those investigations plus (1) the development of process flowsheets and (2) an estimation of process costs and the economics of regeneration. The results of the experimental regeneration process studies confirm the potentially large reductions in the amount of sorbent required by FBC's which can be achieved by regeneration, possibly as high as 80%. The economic projections indicate that at current limestone prices, regeneration is not clearly justified on an economic basis; i.e., the cost of the regeneration process slightly exceeds the anticipated savings in limestone raw material cost which results from the regeneration process. However, the cost of limestone disposal has not been thoroughly addressed. Hence, if disposal costs due to environmental considerations, particularly the Resource Conservation and Recovery Act, become significant, the economic attractiveness of regeneration would be greatly enhanced.

28366 (BNL—27783) **Advanced snyfuels production/power systems utilizing laser particulate control.** Botts, T.; Powell, J.R.; Fillo, J.A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 4p. (CONF-791204—38). NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Portions of document are illegible.

Coal-fired turbines offer an attractive means of generating electrical power using an available resource and near-term technologies. However, in order to maintain adequate turbine blade lifetimes, and thus make such plants economically attractive, better means of hot gas clean-up than those presently available are needed. One possible solution to this problem is the use of intense laser beams augment the conventional body forces in cyclones to increase collector efficiencies for smaller-sized particulates. Finally, plant factors can be increased by means of alternate energy utilization during off-peak periods. One such scheme is to raise steam and perform high temperature electrolysis. It appears as if the hydrogen produced is more useful as a transportable fuel or chemical than as a means of energy storage.

28367 (BNL—27840) **Regenerative Portland cement sorbents for fluidized-bed combustion of coal.** Albanese, A.S.; Sethi, D.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-800428—5). NTIS, PC A02/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Portions of document are illegible.

Portland cements are commercially available construction materials that contain high concentrations of calcium silicates. The silicates are highly reactive towards SO_2 at temperatures and pressures encountered in atmospheric and pressurized FBC's. Of the Portland cements tested, PC III appears to have the highest sulfation capacity when sulfated by SO_2 at FBC conditions. A thermodynamic analysis of the sulfation of calcium silicates indicates that they are capable of reducing the concentration of SO_2 in FBC combustion gases to within the current EPA emission limits. The optimum temperature for sulfation of 16/20 mesh PC III pellets is about 1000°C in comparison to about 875° for natural limestones. The higher observed optimum temperature is an advantage because com-

bustion and power cycle efficiencies tend to increase as bed temperature increases. The reactions for regenerating sulfated calcium silicates are similar to those for regenerating calcium sulfate. However, the equilibrium partial pressures of SO_2 in the reductive decomposition of sulfated silicates are much higher than for sulfate lime. This implies that higher SO_2 concentrations will be attainable in the regenerator off-gas which will result in more economical conversion of SO_2 to sulfur or sulfuric acid. The sulfation capacity and regeneration efficiency of PC III pellets do not deteriorate with repeated sulfation/regeneration cycling. This indicates that PC III pellets are suitable for use in regenerative systems. The sulfation capacity of PC III is independent of pressure up to at least 10 atm.

28368 (DOE/ER/10456—1) **Condensation processes in coal combustion products. Progress report, July 1, 1979-June 30, 1980.** Katz, J.L.; Donohue, M.D. (Johns Hopkins Univ., Baltimore, MD (USA)). Apr 1980. Contract AS02-79ER10456. 12p. NTIS, PC A02/MF A01.

Slag vaporization is a serious problem in high-temperature coal combustion and gasification processes. Cooling of process gas streams causes the slag vapors to condense, but they do not necessarily do so at equilibrium. Predicting the compositions and properties of the condensing species requires modeling the nucleation processes occurring in these systems. This is a report on our progress toward modeling this nucleation process and toward implementing the model with a computer code suitable for design calculations.

28369 (DOE/ET/12328—T1) **Coal combustion by wet oxidation. Wet oxidation of coal for energy production: test plan and partial results. Interim report.** Bettinger, J.A. (Michigan Technological Univ., Houghton (USA)). 10 Jul 1980. Contract FG01-78ET12328. 58p. NTIS, PC A04/MF A01.

A test plan has been developed which will provide the data necessary to carry out design and economic studies of a steam generating facility, employing the wet oxidation of coal as a heat source. It is obvious, from the literature search and preliminary testing, that the higher the reaction temperature, the more complete the combustion of coal. However, operation at elevated temperatures and pressures present difficult design problems, and the necessary equipment is costly. Operation under these conditions can only be justified by the higher economic value of high pressure and temperature steam. With a reduction in temperature from 550°F (228°C) to 450°F (232°C), the operating pressure is reduced by more than half, thus holding down the overall cost of the system. For this reason, our plan is to study both the enhancement of low temperature wet oxidation of coal, and the higher operating regions. The coal selected for the first portion of this test is an Eastern Appalachian high-volatile-A Bituminous type, from the Upper Clarion seam in Pennsylvania. This coal was selected as being a typical high sulfur, eastern coal. The wet oxidation of coal to produce low pressure steam is a process suited for a high sulfur, low grade, coal. It is not intended that wet oxidation be used in all applications with all types of coals, as it does not appear to be competitive, economically, with conventional combustion, therefore the testing will focus on using high sulfur, low grade coals. In the later portion of testing all the available coals will be tested. In addition, a sample of Minnesota peat will be tested to determine if it also can be used in the process.

28370 (FE—2357-59) **PFB coal fired combined cycle development program. Quarterly report, July-September 1979.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1979. Contract EX-76-C-01-2357. 46p. NTIS, PC A03/MF A01.

Major attention has been focused on all activities associated with the execution of the 10 x 100 hour test at the NCB (Coal Utilization Research Laboratory in Leatherhead, England). The prime objective of the test series is to evaluate the material response of clad, coated, and bare condidate turbine materials using coated and uncooled specimens, under representative PFB efflux conditions. Corrosion testing continued in burner rig stands at 1400°F and 1600°F utilizing doped diesel oil (1% S) containing 79 ppM Na and 122 ppM K, and 16 ppM Mg. The maximum exposures accumulated to date are 3603 hours at 1400°F and 3286 at 1600°F. At 1600°F, visual observations of the specimens in test indicates that PFB-5 is more corrosion resistant than GE-2541, as indicated previously. With the exception of aluminized 310 SS, which showed modest resistance at 1400°F, the Fe-base alloy modifications of GE-2541 have shown poor resistance at 1400°F. Visual and metallographic examination of turbine clad airfoils after the 1000 Exxon PFB miniplant test is in progress. Visual examination revealed varying degrees of apparent metal erosion from the leading edges (LE) and concave (CC) airfoil surfaces of all claddings evaluated in both the impulse and reaction type vanes. Fabrication and assembly of the materials test section was completed and the 1000 hour corrosion-erosion test initiated.

28371 (FE—2689-4) **Investigation of fuels containing coal-oil-water emulsions. Fourth quarterly report, 1 July 1978-30 September 1978.** Cherry, N.H,; Stokes, C.S. (Germantown Labs., Inc., Philadelphia, PA (USA)). Oct 1978. Contract EF-77-C-01-2689. 14p. NTIS, PC A02/MF A01.

The assessment of five emulsifiers for the production of stable coal-oil-water emulsions and the determination of the practicability of their use in a boiler system is being investigated. Four emulsifiers are on hand, the fifth is yet to be chosen. Ancillary equipment has been set up and experiments completed on two units. Mounting fixtures are being designed and fabricated for the third and fourth units. The stability of the emulsions is being evaluated on the K-scan unit.

28372 (FE—2762-8) **Formation and control of fuel-nitrogen pollutants in catalytic combustion of coal-derived gases. Quarterly technical progress report, March 15-June 15, 1979.** Bracco, F.V.; Bruno, C.; Santavicca, D.A.; Semler, J.H.; Walsh, P.M. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1 Jul 1979. Contract EF-77-S-01-2762. 52p. NTIS, PC A04/MF A01.

A review was made of the available data on amounts of nitrogen-containing impurities present in coal-derived low and medium-Btu gases. A summary was made of the most complete of the existing models for catalytic combustor operation. A summary of the theoretical and experimental work on ammonia conversion to NO/sub x/ in catalytic combustion of low and medium-Btu gases is given. Experimental investigations were made of carbon monoxide and medium-Btu gas combustion in the presence of platinum supported on a monolithic Cordierite substrate. Axial profiles of substrate temperature, gas temperature, and stable species concentrations were measured at different gas velocities and equivalence ratios. These results have been extended by investigation of the catalytic combustion of medium-Btu gas containing hydrogen sulfide. The two-dimensional computer model being developed to describe catalytic combustion has been expanded by addition of finite rate wall reactions to the chemical kinetic scheme. Computed axial and radial gas temperature and carbon monoxide concentration profiles inside a catalyst channel during carbon monoxide combustion are presented. The integrated carbon monoxide profiles at the catalyst outlet are compared with the experimentally measured values. Summaries of the resonance absorption and Raman scattering techniques for measuring gas temperature and species concentrations in combustion systems were prepared and concepts for applying these techniques to catalytic combustion were developed. A possible approach to minimizing ammonia to NO/sub x/ conversion in catalytic combustion of coal-derived gases is presented.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 28290, 28376

28373 (DOE/EIA—0217(79)) **Coal sales companies in the United States, 1979.** McNair, M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 22 Apr 1980. 50p. NTIS, PC A03/MF A01.

This list of coal sales companies has been compiled by the Coal Statistics Division, Office of Coal and Electric Power Statistics, Energy Information Administration (EIA), Department of Energy, for the purpose of identifying coal sales organizations in the United States that submitted coal distribution data directly to EIA on form EIA 6, Distribution of Bituminous Coal and Lignite Shipments and form EIA 196B, Distribution of Pennsylvania Anthracite for calendar year 1979. The term Coal Sales Companies is used to denote companies that purchase coal from coal producers/mining companies and resell the coal to consumers or to other coal sales companies that ultimately sell to consumers. Coal sales organizations include coal wholesale dealers, coal retail dealers, brokers, and other coal distributing companies. Excluded from this list are coal companies that produce and utilize their own coal exclusively and/or companies that produce and market their own coal exclusively.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 28344, 28345, 28349, 29747, 29754

28374 (DOE/ET/00222—5) **Exploratory research on mutagenic activity of coal-related materials. Progress report for period March 1, 1980 to June 1, 1980.** Warshawsky, D.; Schoeny, R. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1980. Contract AS22--78ET00222. 8p. NTIS, PC A02/MF A01.

Samples ETTM-05 and ETTM-12 (powdered coal) were not mutagenic for any of 4 Salmonella strains. ETTM-18 (solid residual) was mutagenic for strains TA1538, TA98, and TA100 when assayed with Aroclor-induced S-9.

REGULATIONS

28375 (FE—8914-3) **Analysis of the impact of Public Law 95-87 on mining performance.** (Skelly and Loy, Harrisburg, PA (USA)). Jun 1979. Contract ET-77-C-01-8914-003. 417p. NTIS, PC A18/MF A01.

This report analyzes the impact of the 1977 Federal Surface Mining Act and Office of Surface Mining's regulatory program on mining performance. Mining practices and production levels are presented for the four major mining regions in the US. Important compliance requirements and dates in the Federal program are reviewed along with permitting and bonding requirements. Key regulatory provisions affecting mine performance are identified and analyzed in terms of operational impacts. A summary of equipment and technology for mitigating regulatory impacts is provided. The report includes a review of additional compliance costs projected by industry and government agencies. Additional equipment needs and unit operation costs from a survey of existing mines is also included. A scenario analysis of several mines is presented to illustrate the impact of compliance on new mines. Conclusions on major impacts are followed by recommendations for research to improve mining efficiency and offset additional compliance costs.

28376 (GFETC/IC—79/1, pp 108-116) **Lignite and coal in the U.S. energy future.** Fisher, W.L. (Univ. of Texas, Austin). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The dilemma in energy is reviewed in terms of past, present, and future trends and available options. The real price of domestically produced energy has doubled while that of imported energy has nearly tripled. Total US energy production has declined, energy consumption has increased although at a reduced rate, productivity has decreased, and the balance of trade deficit in energy is 50 times the historical level. Because of conservation, the ratio of GNP to energy consumption has been reduced. For significantly increased domestic energy production in the near or mid term, oil, gas, coal and nuclear are the only viable options open. Outlook for increased oil and gas production is difficult and that for nuclear is grim, leaving a heavy reliance on coal. Coal production would have to increase by about 7% a year to reach the goal of 2 billion tons per year by 1990. However, both production and consumption of coal was lower in 1978 than any year since 1975.

28377 (GFETC/IC—79/1, pp 351-356) **Change: Mercer County.** Stroup, R.L. (Energy Development Board of Mercer County, Hazen, ND). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Mercer County is primarily an agricultural area which is undergoing a population explosion generated by rapid development of lignite reserves. About 6.5 million tons of lignite is mined each year, and mining is projected to almost quadruple by 1985. One of its cities has experienced a 72% population growth since 1974. A division of the US Department of Energy (DOE/BCS) sponsored research projects directed towards the methodologies and analytical requirements needed by communities to undertake energy planning and management to minimize negative effects of rapid growth. Mercer County was selected as a study area, and a county-wide Energy Development Board (EDB) was formed in 1977 to coordinate energy-related community development at the local level. Fourteen volunteer board members represent the political subdivision and formulate policies to meet established objectives. Policies are implemented by the EDB staff. Four major functions are being carried out during initial operation until June 1980. A time-phased growth plan is in initial draft form. An energy conservation plan has also been prepared. Monitoring of socio-economic changes related to energy development is one of EDB's major responsibilities. Technical assistance is provided on a day-to-day basis. Coordinated efforts have been successful in that communities are cooperating on a county airport and a medical care project in addition to the comprehensive energy-related efforts.

28378 **Memorandum of understanding BLM-GS-OSM management of Federal coal.** Washington, DC; Bureau of Land Management (1979). 43p.

This Memorandum of Understanding (MOU) establishes the procedures for cooperation and coordination among the Bureau of Land Management (BLM), the Geological Survey (GS), and the Office of Surface Mining Reclamation, and Enforcement (OSM) under the general provisions of the Division of Functions and Responsibilities Concerning Management of Federal Coal as approved by the Under Secretary on July 5, 1978, and published in the Federal Register, Vol. 43, No. 237, December 8, 1978. This MOU sets forth the procedural arrangements by which the three agencies will carry out their functions and responsibilities with respect to operations under Federal coal leases and exploration licenses where the BLM is the responsible surface management agency or where reserved Federal coal is involved. In addition, the MOU recognizes the role of the State governments in regulating surface coal mining and reclamation operations on Federal lands within the State in accordance with a State-Federal Cooperative Agreement executed pursuant to 30 CRF 745 or 30 CFR 211.75. On November 24, 1976, the BLM and GS entered into a working agreement covering onshore mineral lease operations, exclusive of oil, gas, geothermal, and oil shale. This MOU supersedes the working agreement only insofar as said working agreement applies to coal.

PETROLEUM

REFER ALSO TO CITATION(S) 29164

GEOLOGY AND EXPLORATION

28379 (DOE/RA/33211—T1) **Canadian incentives for oil and gas exploration.** (Energy Associates, Concord, MA (USA)). Apr 1980. Contract AC01-80RA33211. 180p. NTIS, PC A09/MF A01.

During the 1970s a number of different exploration and production incentive programs were put in place in Canada, in particular in the Province of Alberta, Canada's principal oil- and gas-producing province. The DOE/RA is evaluating Canadian incentives for oil and gas exploration, and this study is intended to provide information that will help guide DOE/RA in determining the applicability of Canadian incentive programs in US energy policy. The study describes and documents the fiscal structure in which the Canadian oil industry operates. The incentive features of pricing policy, taxation policy, and provincial royalty systems are discussed. A principal focus of the study is on one of the most important of Canada's specific incentive programs, the Alberta Exploratory Drilling Incentive Credit Program (EDICP). The study describes and evaluates the effect of the EDICP on increased oil and gas exploration activity. Similarly, the study also reviews and evaluates other specific incentive programs such as the Alberta Geophysical Incentive Program, Frontier Exploration Allowances, and various tar sand and heavy oil development incentives. Finally the study evaluates the applicability of Canadian incentives to US energy policy.

28380 **Cementing tool and method of utilizing same.** Hix, H.A. US Patent 4,176,717. 4 Dec 1979. Filed date 3 Apr 1978. 12p.

A method of an apparatus for cementing the bore hole of oil and gas wells and the like is provided. The apparatus provides a cementing collar threadedly attachable at each end to a well liner and having an inner sleeve slidably positionable within an outer sleeve. The two sleeves are each provided with openings and ports, respectively, which when radially aligned in register permit fluid to flow from the interior of the inner sleeve to the exterior of the outer sleeve. Radial alignment is effected by means of a series of fingers disposed circumferentially at each end on the inner sleeve and receivable at predetermined locations on the interior surface of the outer sleeve. Means are provided for axially moving the inner sleeve to align the openings with the ports and for thereafter disaligning the same. A method of utilizing the cementing collar apparatus is also provided. 6 figures.

28381 **Well cementing in permafrost.** Wilson, W.N. (to Atlantic Richfield Co.). US Patent 4,181,533. 1 Jan 1980. Filed date 31 Jan 1979. 4p.

A process for cementing a string of pipe in the permafrost region of a borehole of a well wherein aqueous drilling fluid actually used in drilling the wellbore in the permafrost region of a wellbore is employed. The drilling fluid contains or is adjusted to contain from about 2 to about 16 volume percent solids. Mixing with the drilling fluid (1) an additive selected from the group consisting of lignosulfonate, lignite, tannin, and mixtures thereof, (2) sufficient base to raise the pH of the drilling fluid into the range of from about 9 to about 12, and (3) cementitious material which will harden in from about 30 to about 40 hours at 40°F. The resulting mixture is pumped into the permafrost region of a wellbore to be cemented and allowed to harden in the wellbore. There is also provided a process for treating an aqueous drilling fluid after it has been used in drilling the wellbore in permafrost, and a cementitious composition for cementing in a permafrost region of a wellbore.

28382 **Well cementing in permafrost.** Wilson, W.N. (to Atlantic Richfield Co.). US Patent 4,176,720. 4 Dec 1979. Filed date 27 Jul 1978. 6p.

A process for cementing a string of pipe in the permafrost region of a borehole of a well wherein aqueous drilling fluid actually used in drilling the wellbore in the permafrost region of a wellbore is employed. The drilling fluid contains or is adjusted to contain from about 2 to about 16 volume percent solids. Mixing with the drilling fluid (1) an additive selected from the group consisting of lignosulfonate, lignite, tannin, and mixtures thereof, (2) sufficient base to raise the pH of the drilling fluid into the range of from about 9 to

about 12, and (3) cementitious material which will harden in from about 30 to about 40 hours at 40°F. The resulting mixture is pumped into the permafrost region of a wellbore to be cemented and allowed to harden in the wellbore. There is also provided a process for treating an aqueous drilling fluid after it has been used in drilling the wellbore in permafrost, and a cementitious composition fro cementing in a permafrost region of a wellbore.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 28808

28383 Improved method for enhanced oil recovery. Comberiati, J.R.; Locke, C.D.; Kamath, K.I. US Patent Application 034,804. [nd]. 11p.

The present invention is directed to an improved method for enhanced recovery of oil from relatively cold reservoirs by carbon dioxide flooding. In oil reservoirs at a temperature less than the critical temperature of 87.7°F and at a pore pressure greater than the saturation pressure of carbon dioxide at the temperature of the reservoir, the carbon dioxide remains in the liquid state which does not satisfactorily mix with the oil. However, applicants have found that carbon dioxide can be vaporized in situ in the reservoir by selectively reducing the pore pressure in the reservoir to a value less than the particular saturated vapor pressure so as to greatly enhance the mixing of the carbon dioxide with the oil.

28384 Method of determining interwell oil field fluid saturation distribution. Donaldson, E.C.; Sutterfield, F.D. US Patent Application 021,141. [nd]. 27p.

A method of determining the oil and brine saturation distribution in an oil field by taking electrical current and potential measurements among a plurality of open-hole wells geometrically distributed throughout the oil field is described. Poisson's equation is utilized to develop fluid saturation distributions from the electrical current and potential measurement. Both signal generating equipment and chemical means are used to develop current flow among the several open-hole wells.

28385 (CONF-800563—1) **Effect of hydrotropic salts on phase relationships involving hydrocarbons, water, and alcohols.** Ho, P.C.; Kraus, K.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

From SPE international symposium on oil field and geothermal chemistry; Stanford, CA, USA (28 May 1980).

Hydrotropic salts, which can increase the solubility of organic materials in aqueous solutions, are useful to tertiary oil recovery. We have examined effects on solubility of hydrocarbons in water (with and without alcohols) through addition of inorganic hydrotropic salts, such as perchlorates, thiocyanates, and iodides - high in the usual Hofmeister series - and of organic salts such as short chain alkyl benzene sulfonates and other salts based on substituted benzene derivatives. Although the inorganic salts are relatively ineffective in increasing solubility of hydrocarbons in water, many of the organic salts are excellent hydrotropic agents for hydrocarbons. We have examined the phase relationships for several series of aromatic salts such as sulfonates, carboxylates and hydroxycarboxylates, as a function of alkyl-carbon substitution in three-component (hydrocarbon, salt, water) and in four-component (hydrocarbon, salt, alcohol, water) systems. We have also examined miscibility relationships for a given hydrotropic salt as the chain length of alkanes and alkyl benzenes is systematically varied. While miscibilities decrease with increase in chain length of the hydrocarbon, the hydrotropic properties in these systems increase rapidly with the number of alkyl carbons on the benzene ring of the salts and they are relatively insensitive to the type of charged group (sulfonate vs carboxylate) attached to the benzene ring. However, there were significant increases in hydrotropy as one goes from equally substituted sulfonates or carboxylates to salicylates. A number of salts have been identified which have much greater hydrotropic properties for hydrocarbons than such well-known hydrotropic materials as toluene and xylene sulfonates.

28386 (DOE/METC/8024—T1) **Griffithsville unit tertiary recovery carbon dioxide pilot test, Lincoln County, West Virginia. Third and final annual report, August 28, 1977-August 28, 1978.** McRee, B.C. (Guyan Oil Co., Inc., Huntington, WV (USA)). 1 Jul 1979. Contract EW-76-C-21-8024. 40p. NTIS, PC A03/MF A01.

The three-year contract expired on August 28, 1978, without completion of the original intent of testing the effectiveness of carbon dioxide on effective enhanced oil recovery agent, owing to unforeseen problems of environment control, the dump flood and extreme weather condition. However, all of the preparations for carbon dioxide has been accomplished and the pilot is in excellent condition for proceeding with the program. Although cost overruns may be over $1,500,000, additional testing over that programmed indicates that the pilot operation will be more successful than previously hoped for. Guyan Oil Company has developed a two year plan of operation to complete the program.

28387 Oil recovery prediction technique. Frazier, G.D. (to Texaco Inc.). US Patent 4,181,176. 1 Jan 1980. Filed date 6 Nov 1978. 4p.

This method provides a means of determining the optimal injection and production rates for a given well pattern for use in enhanced recovery projects in petroleum reservoirs. A streamtube model for the pattern for a given injection and production rate is determined. Data from this model are plotted as a function of percentage of streamtubes exhibiting breakthrough to production wells versus time. A series of these graphs is plotted for different injection-production rates, and the model exhibiting the highest percentage of streamtube breakthrough within a reasonable time is selected.

28388 Apparatus for positioning an off-shore weight structure on a previously positioned sea bed unit. Vache, J.C. (to Sea Tank Co.). US Patent 4,181,453. 1 Jan 1980. Priority date 24 Aug 1977, United Kingdom of Great Britain and Northern Ireland (UK), 6p.

Apparatus is described for positioning an off-shore weight structure on a previously positioned sea bed unit during lowering of the weight structure onto the sea bed. The sea bed unit comprises a unit template surrounded by a guide structure in the form of a perimeter frame. The weight structure comprises a base caisson of reinforced concrete and at least one hollow reinforced concrete tower projecting upwardly therefrom for supporting a work deck out of the water. Co operating contacts are provided on the sea bed unit and in a sea bed unit receiving recess in the lower surface of the base caisson, and a plurality of anchors are provided for location on the sea bed around the sea bed unit and for fixing to the sea bed independently of the sea bed unit. Co-operating winches are connected to the anchors by cables. During lowering progressively more accurate guide systems are used. The winches enable the recess to come into contact with the guide structure surrounding the template. Camming action between the guide structure and the rim of the recess brings the weight structure very near the required alignment, and finally camming between elements on the template and co-operating elements in the recess completes the procedure, without at any time having to apply undue stress to the sea bed unit. Guidelines lead from the sea bed unit to tension-limiting winches on the work plateform for guide purposes, but the limiting tensions are set so that little force is transmitted from the structure to the sea bed unit via the guidelines.

28389 Slaughter Estate Unit CO_2 Pilot: surface and downhole equipment construction and operation in the presence of hydrogen sufide gas. Adams, G.H.; Rowe, H.G. pp 199-209 of First joint SPE/DOE symposium on enhanced oil recovery. Dallas, TX; Society of Petroleum Engineers (1980).

From SPE/DOE symposium on enhanced oil recovery; Tulsa, OK, USA (20 Apr 1980).

Amoco Production Company's Slaughter Estate Unit Tertiary Pilot was conceived in 1971 as a reservoir test of the carbon dioxide miscible displacement process. Due to difficulties in obtaining a source of pure CO_2, a feed gas stream to the Slaughter Gasoline Plant sulfur recovery unit, seven miles from the pilot site, was chosen as the injection solvent source. This stream consisted of approximately 72% CO_2 and 28% hydrogen sulfide. It was known that the acid gas stream could be safely compressed and transported to the pilot site, since such sour gas streams had been safely handled for years in Canadian and East Texas oil field operations. Design of the surface equipment and ordering of materials took place during 1972 and 1973. Construction of the compressor station took place during portions of 1974 and 1975, and installation of the 7.2 mile (11.6 km) acid gas transmission line took place during the first half of 1974. This paper presents the selection of materials and protective equipment, as well as procedures followed and safety precautions taken during installation. The paper also documents the precautions taken in the design and operation of the Slaughter Estate Unit pilot with respect to the safe handling of the acid gas stream, and presents operational experience during the miscible gas injection phase of the project.

PROCESSING

REFER ALSO TO CITATION(S) 29510

28390 Method for combusting carbon monoxide in a fluid catalytic cracking process. Luckenbach, E.C. (to Exxon Research and Engineering Co.). US Patent 4,180,454. 25 Dec 1979. Filed date 3 Jan 1978. 12p.

A minor portion of the regeneration gas used to regenerate spent fluid catalytic cracking catalyst is passed into a distribution means located at the interface between the dense phase catalyst bed and the dilute catalyst phase in the regeneration zone of a fluid

catalytic cracking process to combust, at said interface, the carbon monoxide formed in said bed to carbon dioxide. In a preferred embodiment, the level of the dense phase bed can be adjusted to vary the amount of catalyst entrained in the dilute catalyst phase such that the distribution means will be partially submerged. This serves to provide a simple and convenient method to absorb the heat released by the oxidation of carbon monoxide, thereby minimizing or eliminating excessive or undesirable afterburning in the dilute catalyst phase and in equipment downstream thereof. 2 figures.

28391 Process for desalting and dehydration of crude oil including hot water washing and gas stripping. Popp, V.V.; Suditu, I.; Neagu, P.; Fotescu, L.; Mihalache, I.; Tirboiu, D. (to Trustul Petrolului Bolintin). US Patent 4,180,457. 25 Dec 1979. Filed date 17 Jan 1978. 6p.

Process and apparatus for the desalting and dehydration of crude oil is described, in which the crude oil is washed in one or several stages using fresh or recirculated hot water containing a demulsifier. The crude oil is also passed through a coalescence stage, and a settling stage aimed at obtaining a salt content to meet crude oil specifications. Subsequently the crude oil is led into a lower stripping compartment of a column, in which dehydration is carried out to the desired level by using fuel or combustion gas. The stripping temperature is reached by heating the crude or the gas or both. The gas-vapor mixture is cooled in the upper compartment of the column by a cooling fluid such as the untreated crude oil or recirculated or fresh water, depending upon the nature and salt content of the crude. The cooled gas is recirculated within the column or led to a pipeline for consumption, while the cooling fluid, in the case of water, is recirculated in the unit.

28392 Process for producing premium coke from vacuum residuum. McConaghy, J.R.; Poynor, P.C.; Friday, J.R. (to Conoco, Inc.). US Patent 4,178,229. 11 Dec 1979. Filed date 22 May 1978. 8p.

Low value heavy hydrocarbonaceous material such as a petroleum refinery vacuum residuum is converted to distillate products and pitch in a hydrogen donor diluent cracking process, and the pitch is utilized as feedstock to a delayed preimium coker. 2 figures, 1 table.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 28392, 28396, 29186

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 29747, 29756

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 28397, 29189, 29193, 29209

28393 (DOE/EIA—6039-01) **Price controls and international petroleum product prices.** Deacon, R.T.; Mead, W.J.; Agarwal, V.B. (California Univ., Santa Barbara (USA). Community and Organization Research Inst.). Feb 1980. Contract AT03-79ET15391. 164p. NTIS, PC A08/MF A01.

The effects of Federal refined-product price controls upon the price of motor gasoline in the United States through 1977 are examined. A comparison of domestic and foreign gasoline prices is made, based on the prices of products actually moving in international trade. There is also an effort to ascribe US/foreign market price differentials to identifiable cost factors. Primary emphasis is on price comparisons at the wholesale level, although some retail comparisons are presented. The study also examines the extent to which product price controls are binding, and attempts to estimate what the price of motor gasoline would have been in the absence of controls. The time period under consideration is from 1969 through 1977, with primary focus on price relationships in 1970-1971 (just before US controls) and 1976-1977. The foreign-domestic comparisons are made with respect to four major US cities, namely, Boston, New York, New Orleans, and Los Angeles. 20 figures, 14 tables.

WASTE MANAGEMENT

28394 New re-refining technologies of the western world. Whisman, M.L. (Dept. of Energy, Bartlesville, OK). *J. Am. Soc. Lubr. Eng.;* **35**: No. 5, 249-253(May 1979).

Rulings prohibiting dumping or storing in sludge pools of used motor lubricating oils and the dwindling oil reserves of the world have served to spur development of new technological processes for re-refining of used motor oil. Various re-refining processes developed in both Europe and the US are reviewed. The Recyclon Process developed in Switzerland in collaboration with a West German company consists of chemical treatment of the previously dried oil with a soldium emulsion followed by distillation recovery of the basic oils. A vacuum distillation technic for recovery has been developed by Kinetics Technology International (KTI) or Zoetermeer, the Netherlands. A propane precipitation technology developed at the Institut Francois de Petrole (IFP) is currently being used by at least two firms in Italy. IFP is now working on a membrane filtration treatment of the pretreated oil. A process recently developed by the Phillips Petroleum Co. called the PROP process includes chemical precipitation of contaminants, separation of oil and precipitate, removal of additional contaminants with clay, and hydrogenation to produce a good final product. Another process developed in the US by the Bartlesville Energy Research Center, the BERC Process, involves dehydration and production of a fuel cut in a staged distillation, solvent extraction to remove coking and fouling precursors, recovery of solvent, distillation of the feedstock, and either clay finishing or hydrofinishing. Advantages and disadvantages of all processes are noted. (BLM)

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 29588, 29613, 29632, 29742

28395 (EPA/600/9—79-007) **Small oil spill at West Falmouth.** Jacoff, F.S. (ed.). (Environmental Protection Agency, Washington, DC (USA)). Mar 1979. 29p. NTIS.

This is a report about oil and its effects in marine environments, a technically complex subject that is further shrouded by controversy between conflicting interests. This report focuses on an investigation of a modest oil spill which occurred at West Falmouth, Massachusetts in September, 1969. The work comprises what is probably the most rigorous and comprehensive investigation ever made of a single spill event. The West Falmouth study provides a solid advance in the understanding of oil pollution in the ocean, and its effects on coastal areas.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 28393, 29186, 29193

28396 (DOE/RG—0038) **Progress report to Congress on the standby motor fuel rationing plans.** (Department of Energy, Washington, DC (USA). Office of Regulations and Emergency Planning). Jun 1980. 84p. NTIS, PC A05/MF A01.

Part 1 of this report gives introductory material. Part 2 summarizes the standby gasoline rationing plan; describes the differences between this plan and the one that was transmitted by the President to the Congress on March 1, 1979; and cites some problems inherent in rationing gasoline. Part 3 describes the mechanisms contained in the plan for meeting the gasoline needs of end users: the basic allotments for individuals, basic allotments for firms, hardship allotments, and the ration rights market. Part 4 contains a discussion of the ration rights market, an analysis of the gains that result from permitting the exchange of coupons, and an estimate of what the price of a coupon would be in a 20 percent shortfall. Part 5 examines the economic impacts of the plan: how rationing would affect the average motorist in a 20 percent shortfall, how the plan would affect households in different income groups, and how rural, suburban and urban households would fare under rationing. The appendix to Part 5 contains an analysis of the alternative of issuing allotments to all licensed drivers and compares this alternative with the allotment mechanism based on motor vehicles. Part 6 provides a description of the measures taken to date, since the enactment of the EECA, to develop a gasoline rationing system, and the costs of these measures. Part 6 also includes a discussion of the measures necessary to bring the system to a satisfactory state of readiness, the estimated costs of these measures, and a timetable for their completion.

28397 (EMD—80-34) **Gasoline allocation: a chaotic program in need of overhaul.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 23 Apr 1980. 107p. General Accounting Office, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The 1979 gasoline shortage was another reminder of the continued US dependence on foreign oil supplies and the ever-present threat of supply disruptions. It also underscored our lack of preparedness to minimize the impact of such disruptions. This report examines why the Department of Energy's allocation program was ineffective in managing the shortage and makes recommendations for improving the program.

COMBUSTION

REFER ALSO TO CITATION(S) 28371, 28928, 28929

NATURAL GAS

REFER ALSO TO CITATION(S) 29164

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 28379, 28380

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 28349, 28400

28398 Gas conditioning conference. Norman, OK; University of Oklahoma (1979). 258p. (CONF-7903119—).

From Gas conditioning conference; Norman, OK, USA (5 Mar 1979).

Fifteen papers were presented at the 1979 Gas Conditioning Conference. Individual papers were processed.

HEALTH AND SAFETY

28399 (DOE/EV/06020—T2) **Control and extinguishment of LPG fires. Final report.** (Applied Technology Corp., Norman, OK (USA)). Jun 1980. Contract AC05-78EV06020. 121p. NTIS, PC A06/MF A01.

Approximately 100 fire control and fire extinguishment tests were run on free-burning LPG pool fires from 25 ft^2 to 1600 ft^2 in area. The LPG was contained in concrete pits, and the pit floors were allowed to cool before the fires were ignited so that the burning rates were not influenced by boiloff from the warm floor. High expansion foam was used for fire control. The foam was applied from fixed generators located on the upwind side of the pit. Fires were controlled after foam application of less than a minute to about 10 minutes, depending on the application rate. Fires were extinguished with dry chemical agents applied through fixed piping systems with tankside nozzles and by manual application using hoselines and portable extinguishers. Fires could readily be extinguished in times ranging from a few seconds to about half a minute, depending on the application rate, system design, and ambient conditions. Additional tests were conducted in 1-ft^2 and 5-ft^2 pits to determine the boiloff rates for LPG spilled on concrete, a sand/soil mix, and polyurethane foam substrates. Burning rates for free-burning LPG pool fires from 1 ft^2 to 1600 ft^2 in area are also reported.

MARKETING AND ECONOMICS

28400 (DOE/EIA—0133(78)) **World natural gas, 1978. Energy data report.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1980. 39p. NTIS, PC A03/MF A01.

World marketed production of natural gas in 1978 totaled 51,749 billion cubic feet as compared with 50,100 billion cubic feet during 1977. The following data are presented in tabular form: natural gas production by country; gross production of natural gas by type of well; natural gas used for repressuring or wasted; and world natural gas trade.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

28401 (DOE/BC/10003—8) **Western Gas Sands Project. Quarterly basin activities report, January 1-March 31, 1980.** (CER Corp., Las Vegas, NV (USA)). 1980. Contract AC08-79BC10003. 39p. NTIS, PC A03/MF A01.

This report is a summary of drilling and testing activities in the four primary study areas of the WGSP: Greater Green River Basin, Northern Great Plains Province, Uinta Basin, and Piceance Basin. (DLC)

28402 (UCRL—50036-79-4) **LLL Gas Stimulation Program. Quarterly progress report, October-December 1979.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J.; Towse, D.F.; Lin, W.; Thorson, L.D.; Cleary, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

This report summarizes the research and activities of the LLL Gas Stimulation Program during the final quarter of FY 1979. We have continued our theoretical model development and application. Analyses of frictional interfaces, with similar materials on both sides of the interface, show that frictional slippage along the interface tends to draw a pressurized fracture toward the interface. Increasing friction along the interface changes the position at which the pressurized fracture is affected by the interface. The dynamic effects of propagation near a well-bonded interface between two dissimilar materials are not significantly modified by the velocity of the dynamically propagating fracture for fracture by velocities below the body wave speeds. We have shown the pressure evaluation of the fracturing fluid in a crack. One notable feature of these calculations is the rather sudden increase in fluid pressure at the fracture tip just after the fluid reaches it. Frictional interface experiments using various lubricants on the interface show distinct changes in the frictional coefficient; however, these tests indicate that the interface must support about 350 psi (24 GPa) in shear (frictional) stress before a fracture will penetrate the interface. Our studies of the occurrence and mechanics of natural fractures in the western reservoirs show that in a relaxed tectonic setting, one principal stress is most often nearly vertical and the other two are horizontal. Local stresses that control small fractures such as joints may be different from, although compatible with, the regional stresses. Fractures are controlled by the physical environment, the stresses, and changes in stresses due to burial and uplift. Jointing frequency is greater in weak and thinly bedded rocks and is directly related to the intensity of folding.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 28567

PROPERTIES

REFER ALSO TO CITATION(S) 28417

COMBUSTION

REFER ALSO TO CITATION(S) 29503, 29504, 29505, 29506

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

28403 Origin, deposition, and alteration of the organic material in Green River shale. Robinson, W.E. (Laramie Energy Research Center, WY). *Org. Geochem.;* 1: No. 4, 205-218(Dec 1979).

From Symposium on sedimentary basins and the origin of fossil fuels (Part 1); Jerusalem, Israel (9 Jul 1978).

Characteristics of the organic material in Green River formation shale suggest that this material was derived from algae that grew in ancient Eocene lakes. The basin depressions for these nonmarine lakes were formed by the uplifting of the Rocky Mountain ranges. Large quantities of soluble salts flowed into these basins from the mountain streams. In the upper, relatively fresh-water section of the lakes, abundant quantities of microscopic algae and other biota grew. Lesser amounts of terrestrial plant life remains were supplied in the form of wind- or water-borne spores and in the form of water-soluble organic materials entering the in-flowing waters. The lower section of the lake waters became highly reducing and stagnant because of lack of seasonal oxidative turnovers, thus providing ideal conditions for the accumulation and preservation of the organic debris from the lake biota. Precipitation of mineral carbonates and silicates from the highly saline waters provided most of the minerals that were co-deposited with the organic matter. Carbon dioxide, which evolved from the aquatic plant life, probably influenced mineral carbonate precipitation. During the life span of a few million of years the characteristics of the lake waters varied considerably and had significant effect upon the composition of both the inorganic and organic constituents of the Green River shale. Sixty to seventy-five core samples from each of three basins of the Green River Formation were analyzed for changes in both the organic and inorganic constituents. Considerable differences in the organic components of the soluble bitumen and of the insoluble kerogen were evident. Some of these differences appeared to be

related to depth of burial and some to source material and the environment of the lake waters. Compositional differences relative to lithologic differences in the sediments of the three basins were found. 2 figures, 9 tables.

DRILLING, FRACTURING, AND MINING

28404 (FE—2346-43) **Energy from true in situ processing of Antrim shale: preparation of a cavity by chemical underreaming.** Peil, C.A.; Cochran, G.A. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Apr 1980. Contract AC01-76ET12153. 59p. (DOW/SR—43). NTIS, PC A04/MF A01.

The contract between the Dow Chemical Company and the Department of Energy to investigate the feasibility of recovery of energy from the Antrim shale by an in situ process includes a task titled, In Situ Fracturing and Assessment. This task required Dow to conduct and evaluate three fracturing techniques: hydraulic fracturing followed by explosive fracturing; chemical underream followed by explosive fracturing; and explosive underream and fracturing. The work carried out in the chemical underream subtask is summarized. Two distinctly different field methods were attempted. Hydrochloric acid treatment in the limestone section resulted in creating a cavity less than of the expected size. An attempt to produce a horizontal fracture in the limestone failed to establish the communication required to solution mine the limestone section between the injection and four production wells. Communication between the wells was an essential ingredient for success. In the second field trial, not having achieved this, neither the acidization or the originally planned explosive fracturing experiments were attempted. It was concluded that with current technology applied to these particular field conditions, the other two techniques offered the best short-term potential for success.

28405 (FE—2346-65) **Energy from true in situ processing of Antrim shale: preparation of an in situ retort bed by hydraulic fracturing.** Peil, C.A. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). May 1980. Contract AC01-76ET12153. 76p. NTIS, PC A05/MF A01.

Under these specific field conditions, utilization of the natural tendency of the formation to fracture vertically provided the basis for this revised experiment. Observations made during hydrofracturing and permeability testing indicate that a complicated but extensive fracture system exists in the 100 series wells. An efficient and effective borehole loading system was developed after considerable effort. Borehole explosives improved permeability and communications significantly over that which existed before explosive fracturing. The use of hydrofractured and propped fractures was effective and dramatically demonstrated by cement traversing from one well to another. Fluid control remained a problem and would become more significant during any in situ retorting trials. The results of this experiment are encouraging when compared with those experienced in our front site test area. However, on the basis of better fluid control, overall communications and a wider range of operating pressures, the explosive underream and fracturing experiment was chosen as the site for the in situ extraction trial. No further work is planned on this task.

OIL PRODUCTION, RECOVERY, AND REFINING

28406 (DOE/ET/14102—2) **Synthetic fuels from US oil shales: a technical and economic verification of the HYTORT Process. Quarterly report, January 1-March 31, 1980.** (Institute of Gas Technology, Chicago, IL (USA)). Jun 1980. Contract AC01-79ET14102. 71p. NTIS, PC A04/MF A01.

Objective is to demonstrate the technical and economic feasibility of the HYTORT process for both Eocene and Devonian shales. The program is divided into five major task areas: laboratory program, bench-scale program, process development unit tests, process environmental assessment, and process design and economics. (DLC)

28407 **DOE's 1979 oil shale R and D program.** Hartstein, A.M. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **33**: 15-16(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 28404

28408 (DOE/LC/10036—T3) **Occidental vertical modified in situ process for the recovery of oil from oil shale, Phase II. Quarterly progress report, December 1, 1979-February 29, 1980.** McDermott, W.F. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Mar 1980. Contract FC20-78LC10036. 262p. NTIS, PC A12/MF A01.

The major activities at OOSI's Logan Wash site during the quarter were: driving the access drifts toward the underground locations for Retorts 7 and 8; raise boring; change house construction; Mini-Retort (MR) construction and MR outlet pipe protection testing; (an OOSI funded-program) and revision of the underground electrical system to support mining.

28409 (DOE/LETC/EA—0114) **Environmental assessment: Geokinetics, Inc. oil shale research project, Uintah County, Utah.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy). Dec 1979. 68p. NTIS, PC A04/MF A01.

Geokinetics, Inc. (GKI) proposes to complete the remaining experimental program to develop the LOFRECO modified horizontal in situ oil shale retorting process. This Environmental Assessment Report addresses the impacts of the project, located in a remote area of east-central Utah, about 70 miles south of both Vernal and Roosevelt.

28410 (FE—2346-42) **Energy from true in situ processing of Antrim oil shale: initial in situ extraction trials.** McNamara, P.H. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Apr 1980. Contract AC01-76ET12153. 170p. NTIS, PC A08/MF A01.

This report covers the three in situ extraction trials performed at The Dow Chemical Company's existing oil shale site near Peck, Michigan, from August 11, 1977 to May 24, 1978 and the subsequent analysis. The trials were conducted at a depth of 1200 to 1300 feet for a total operating time of 109 days. Ignition was achieved by an electric heater and by a propane burner using coal and charcoal to increase the input of energy. Gas having an energy value of 50 to 55 Btu/scf was prodcued. The energy recovered in the third and most productive trial compared to the energy used for ignition reached a ratio of 4.8. A cyclic operation, called Huff and Puff, gave a 47 to 65% improvement in energy recovery compared to a single forward combustion. No sulfur compounds were detected in the production gas. Particulate measurement was not of value in monitoring the burning process. The trials reported, and the information gathered for them, provide a basis for a trial at a new site adjacent to the existing site.

28411 (OTA-M—118) **Assessment of oil shale technologies.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jun 1980. 526p. GPO.

For many decades, the oil shale resources of the western United States have been considered possible contributors to the Nation's liquid fuel supply. This volume reviews several paths to development of these resources and the likely consequences of following these paths. A chapter providing background information about the nature of oil shale is followed by an evaluation of technologies for recovery of shale oil. The economics and finances of establishing an industry of various sizes are analyzed. The fact that much of the best shale is located on Federal land is examined in light of the desire to increase use of the resources. The consequences of shale development in terms of impact on the physical and social environments, and a discussion of the availability of water complete the report. Policy options addressing barriers that could hinder the establishment of the industry are presented. These options, designed primarily for Congressional consideration, are limited to the obstacles OTA identified as currently existing. Other issues, of equal importance for the protection of the environment and the communities, but not constraints to development, are discussed in the body of the report. The assessment deals only with oil shale; no systematic attempt was made in this study to compare this energy source with liquid fuel sources other than conventional petroleum or with alternative energy strategies. Other OTA assessments are addressing many of these topics.

28412 (UCRL—52942) **Economics of shale oil production by radio frequency heating.** Mallon, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 May 1980. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01.

A conceptual facility for the production of shale oil by radio frequency(rf) heating has been designed to evaluate the economic feasibility of this technique. In the proposed procedure, the shale is processed in situ without being rubbed or explosively fractured. Metal electrodes inserted in a set of vertical drill holes are energized by a group of rf oscillators. The holes bound a block of shale that is to be retorted. The electric field is developed in such a way that heating within the block is almost uniform, and heating outside the block is very low. Retorting of the shale results in a pressure buildup of the hydrocarbon fluids. The oil and gas move horizontally (parallel to bedding planes), then down the electrode holes to a collection manifold. The facility schedule is planned so that off-peak electric power from existing generating stations can be used to operate the oscillators. Thus, the cost of power and the capital requirements for the facility are held to a minimum. Oil production costs and capital requirements indicate that the proposed procedure is economically

attractive. The two principal costs are purchase of electric power and mining operations. The largest capital requirement is oscillators and associated electrical equipment.

28413 Gas collection system for oil shale retort. Ridley, R.D.; Burton, R.S. III. (to Occidental Oil Shale, Inc.). US Patent 4,181,361. 1 Jan 1980. Filed date 6 Dec 1976. 6p.

An in-situ oil shale retorting process is described in which a cavity filled with broken particles of oil shale is formed within the subsurface oil shale formation and air is forced down through the cavity to sustain combustion of the top layer of oil shale particles, the products of combustion being withdrawn at the bottom of the cavity. A plurality of exhaust pipes traverse the bottom of the cavity and extend out through the sealed entrance to the retort cavity. The pipes are supported above the floor of the cavity and have holes opening on the bottom side of the pipes through which the product gases are withdrawn from the cavity. Valves in each pipe control the flow so as to balance the flow distribution of air and exhaust gases through the retorting cavity.

28414 Liquid seal for production level bulkhead for in situ oil shale retort. Burton, R.S. III. (to Occidental Oil Shale, Inc.). US Patent 4,181,362. 1 Jan 1980. Filed date 11 Sep 1978. 10p.

An in-situ oil shale retort is formed in a subterranean formation containing oil shale. The retort contains a fragmented permeable mass of formation particles containing oil shale. During retorting, oxygen-supplying gas is introduced into an upper level of the fragmented mass for establishing a combustion zone and for advancing the combustion zone through the fragmented mass. Liquid and gaseous products, including shale oil and off gas, are withdrawn from a sealed portion of a production level drift which extends laterally away from the lower level of the fragmented mass. A bulkhead sealed across the drift inhibits passage of off gas from behind the bulkhead to the portion of the drift on the side of the bulkhead opposite the fragmented mass. Off gas, shale oil and water are separately withdrawn from behind the bulkhead. A liquid level is maintained against the srface of the bulkhead facing the fragmented mass to seal the lower edge of the bulkhead and the drift floor adjacent the bulkhead against the passage of off gas through any rock fissures which can be present in the floor of the drift.

SURFACE METHODS

28415 (UCRL—84048) **Possible mechanism of alkene/alkane production in oil shale retorting.** Burnham, A.K.; Ward, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 8p. (CONF-800814—3). NTIS, PC A02/MF A01.

From American chemical society meeting; San Francisco, CA, USA (24 Aug 1980).

The purpose of the work reported is to clarify the reaction mechanisms which determine the observed alkene/alkane ratios under various conditions. The C_1 to C_5 hydrocarbons and hydrogen were measured as a function of time for oil shale heated at a constant rate. The effect of an inert sweep gas on the time-dependent ethene/ethane and propene/propane ratios and the integral 1-alkene/n-alkane ratios in the oil were also determined. It is shown that the C_2H_4-C_2H_6-H_2 system is not in thermal equilibrium. Results are interpreted in terms of a nonequilibrium free radical mechanism proposed by Raley.

PURIFICATION

28416 Process for treating hot shale oil effluent from a retort. Jensen, H.P. (to Chevron Research Co.). US Patent 4,181,596. 1 Jan 1980. Filed date 29 Mar 1978. 8p.

Oil shale retort effluent having a temperature of at least 650°F (343°C) is cooled, if necessary, to within the range from 600 to 800°F (316 to 427°C), separated into a liquid phase and a vapor phase, and the liquid phase is maintained within that range for 1 to 120 minutes to form a liquid product having a pour point less than 40°F (4.4°C). When the effluent contains at least one contaminant selected from soluble iron and soluble arsenic and is withdrawn from the retort at a temperature of at least 300°F (149°C), maintaining the liquid phase at a temperature from 300 to 800°F (149 to 427°C) will cause formation of (1) a precipitate containing iron, arsenic or both and (2) a liquid product having a reduced contaminant content.

PROPERTIES AND COMPOSITION

28417 (MLM-MU—80-61-0015) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1-December 31, 1979.** Zielinski, R.E.; Nance, S.W. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract AC04-76DP00053. 198p. (MLM-EGSP-TPR-Q—012). NTIS, PC A09/MF A01.

The report primarily contains the well drilling status and the physicochemical characterization of samples from OH-4 (Ashtabula County, Ohio) and PA-3 (Erie County, Pennsylvania) wells.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 29754

28418 (LA-UR—80-1852) **Industrial hygiene concerns associated with oil shale development.** Ettinger, H.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 16p. (CONF-800822—1). NTIS, PC A02/MF A01.

From Oil shale: the environmental challenges conference; Vail, CO, USA (11 Aug 1980).

Health protection concerns (including industrial hygiene, safety, and occupational medicine) must be evaluated to insure that development of the oil shale industry proceeds without significant risk to the health of the workers involved. These concerns need to be identified in the early stages of developing this industry. To provide a basis for discussing potential health protection concerns related to oil shale, it is necessary to briefly discuss the magnitude and characteristics of this resource; the alternate proposed technologies; and the unit operations which make up the operating system. This subject has been detailed in many publications, among them reports prepared for the Environmental Protection Agency. This discussion will be limited to providing sufficient background to put industrial hygiene and other health protection concerns in perspective, and will include a brief description of typical technologies under consideration. It will not provide a detailed description of these technologies, or attempt to cover all the alternate technologies which may be applied to the development of oil shale. However, a basis for considering potential health protection problems associated with development of this industry will be established.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 28409, 28411

NUCLEAR FUELS

NUCLEAR FUELS

28419 Design of nuclear fuel cycle facilities. Massey, J.V. (Georgia Inst. of Tech., Atlanta). *Trans. Am. Nucl. Soc.;* **33**: 121-122(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

RESERVES

REFER ALSO TO CITATION(S) 28428, 29176

28420 Nature of and exploration for uranium in sandstone deposits in the United States: an educational module. Brookins, D.G. (Univ. of New Mexico, Albuquerque). *Trans. Am. Nucl. Soc.;* **33**: 119-120(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

EXPLORATION

REFER ALSO TO CITATION(S) 28420, 29378, 29570

28421 (DP-MS—79-84) **Stream sediment geochemical surveys for uranium.** Price, V.; Ferguson, R.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract AC09-76SR00001. 40p. (CONF-791156—3). NTIS, PC A03/MF A01.

From Geological Society of America annual meeting; San Diego, CA, USA (5 Nov 1979).

Stream sediment is more universally available than ground and surface waters and comprises the bulk of NURE samples. Orientation studies conducted by the Savannah River Laboratory indicate that several mesh sizes can offer nearly equivalent information. Sediment is normally sieved in the field to pass a 420-micrometer screen (US Std. 40 mesh) and that portion of the dried sediment passing a 149-micrometer screen (US Std. 100 mesh) is recovered for

analysis. Sampling densities usually vary with survey objectives and types of deposits anticipated. Principal geologic features that can be portrayed at a scale of 1:250,000, such as major tectonic units, plutons, and pegmatite districts, are readily defined using a sampling density of 1 site per 5 square miles (13 km^2). More detailed studies designed to define individual deposits require greater sampling density. Analyses for elements known to be associated with uranium in a particular mineral host may be used to estimate the relative proportion of uranium in several forms. For example, uranium may be associated with thorium and cerium in monazite, and with zirconium and hafnium in zircon. Readily leachable uranium may be adsorbed to trapped in oxide coatings on mineral particles. Soluble or mobile uranium may indicate an ore source, whereas uranium in monazite or zircon is not likely to be economically attractive. Various schemes may be used to estimate for form of uranium in a sample. Simple elemental ratios are a useful first approach. Multiple ratios and subtractive formulas empirically designed to account for the presence of particular minerals are more useful. Residuals calculated from computer-derived regression equations or factor scores appear to have the greatest potential for locating uranium anomalies.

28422 (DP-MS—79-101) **Some results of processing NURE geochemical sampling in the northern Rocky Mountain area.** Thayer, P.A.; Cook, J.R.; Price, V. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 27p. (CONF-800593—1). NTIS, PC A03/MF A01.

From American Geological Society Rocky Mountain Section meeting; Ogden, UT, USA (16 May 1980).

The National Uranium Resource Evaluation (NURE) program was begun in the spring of 1973 to evaluate domestic uranium resources in the continental United States and to identify areas favorable for uranium exploration. The significance of the distribution of uranium in natural waters and sediments will be assessed as an indicator of favorable areas for the discovery of uranium deposits. This paper is oriented primarily to the discussion of stream sediments. Data for the Challis 1° x 2° NTMS quadrangle will be used for specific samples of NURE data processing. A high-capacity neutron activation analysis facility at SRL is used to determine uranium and about 19 other elements in hydrogeochemical samples. Evaluation of the areal distributions of uranium ratios demonstrate that most of the high U/Hf, U/Th and U/(Th + Hf) ratios occur scattered throughout the western two-thirds of the quadrangle. Most of the higher ratio values are found in samples taken at sites underlain by granitic rocks of the Idaho batholith or Tertiary-age plutons.

28423 (GJBX—127(80)) **Geology and uranium resources in Precambrian conglomerates of the Nemo area, Black Hills, South Dakota. Final report.** Redden, J.A. (South Dakota School of Mines and Technology, Rapid City (USA)). May 1980. Contract AC13-76GJ01664. 201p. NTIS, PC A10/MF A01.

The detailed work at a 1:3000 scale was done using a generalized grid system. Surface radioactive surveys used a GAD-6 spectrometer. Magnetometer surveys were also made of the Tomahawk, Steamboat Rock, Little Elk, and Greenwood areas in order to confirm the geologic interpretations. The drill core was logged, all radioactive or pebble-bearing intervals split and ground, and samples prepared for analysis by the writer, L. Alstead, and J. D. Kim. Chemical analyses were largely by neutron activation methods and were done in the Uranium Resource Evaluation Laboratory, Union Carbide Corporation, Oak Ridge, Tennessee. Personnel from that laboratory also prepared statistical data on the chemical analyses. Samples were also collected for mineralogic studies using thin sections, heavy mineral separates, and polished plates for use with the NEC energy dispersive x-ray spectroscopy system and electron probe. Some samples of pyritiferous conglomerate were successfully disaggregated using a hydrofluoric acid bath. Zircon concentrates were prepared using heavy liquids and repeated magnetic separation. Drill hole K, U, and Th logs of the different holes were made by Bendix Field Engineering Corporation personnel but due to instrument malfunction, the logs were not interpretable. Scintillation counter logs of the drill core were made during the lithologic logging.

28424 (GJBX—128(80)) **Newark 1° x 2° NTMS area, New Jersey, New York, and Pennsylvania. Data report.** Heffner, J.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1980. Contract AC13-76GJ01664. 502p. (DPST—79-146-9). NTIS, PC $24.50/MF $3.50.

Results of ground water, stream sediment, and stream water reconnaissance in the National Topographic Map Series Newark 1° x 2° quadrangle are presented. Stream sediment and stream water samples were collected from small streams at 840 sites or at a nominal density of one site per 20 square kilometers in rural areas. Ground water samples were collected at 1217 sites or at a nominal density of one site per 15 square kilometers. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water and surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Key data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) well depth, (3) elemental analyses (U, Br, Cl, F, Mn, Na, and V), and (4) graphical presentation only of Al and Dy analyses. Supplementary data include site descriptors (well age, frequency of use of well, etc.) and tabulated analytical data for Al and Dy. Key data from stream sediment sites include (1) water quality measurements, and (2) important elemental analyses (U, Th, Hf, Al, Ce, Fe, Mn, Sc, Na, Ti, and V). Supplementary data from stream sediment sites include sample site descriptors (stream characteristics, vegetation, etc.) and additional elemental analyses (Dy, Eu, La, Lu, Sm, and Yb). Key data from stream water sites include (1) water chemistry measurements and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V).

28425 (GJBX—130(80)) **Gravimeter studies of shallow structure relating to uranium on the northwest flank of the Sierra Madre, Wyoming. Final report.** Smithson, S.B. (Wyoming Univ., Laramie (USA). Dept. of Geology). Apr 1980. Contract AC13-76GJ01664. 27p. NTIS, PC A03/MF A01.

Tertiary sedimentary rocks onlap Archean uranium-bearing conglomerates along the northwest flank of the Sierra Madre, a Precambrian cored Laramide uplift in southern Wyoming. The Archean conglomerates are a potential source of uranium but their depth beneath the Tertiary sedimentary cover is unknown. Drilling has been carried out to evaluate the economic potential of uraniferous conglomerate in the exposed Archean rocks. The conglomerates strike SW, under Tertiary rocks and one borehole was started in Tertiary rocks along the strike projection to determine depth to the conglomerate. In tracing the conglomerate beneath the sedimentary rocks and in estimating potential minable reserves, depth is critical. Depth information can be obtained by drilling, but because flat-lying Tertiary sediments cover earlier features including Precambrian topography and possible faulting along the flank of the uplift, drilling the sedimentary cover could meet with geologic surprises such as faults and be expensive. Geophysical methods can also give depth information and may be economically applied before drilling in order to eliminate some of the uncertainty.

28426 (GJBX—133(80)) **Hydrogeochemical and stream sediment detailed geochemical survey for Edgemont, South Dakota; Wyoming.** Butz, T.R.; Dean, N.E.; Bard, C.S.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 May 1980. Contract W-7405-ENG-26. 385p. (K/UR—38). NTIS, PC $20.50/MF $3.50.

Results of the Edgemont detailed geochemical survey are reported. Field and laboratory data are presented for 109 groundwater and 419 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwaters containing greater than or equal to 7.35 ppB uranium are present in scattered clusters throughout the area sampled. Most of these groundwaters are from wells drilled where the Inyan Kara Group is exposed at the surface. The exceptions are a group of samples in the northwestern part of the area sampled and south of the Dewey Terrace. These groundwaters are also produced from the Inyan Kara Group where it is overlain by the Graneros Group and alluvium. The high uranium groundwaters along and to the south of the terrace are characterized by high molybdenum, uranium/specific conductance, and uranium/sulfate values. Many of the groundwaters sampled along the outcrop of the Inyan Kara Group are near uranium mines. Groundwaters have high amounts of uranium and molybdenum. Samples taken downdip are sulfide waters with low values of uranium and high values of arsenic, molybdenum, selenium, and vanadium. Stream sediments containing greater than or equal to 5.50 ppM soluble uranium are concentrated in basins draining the Graneros and Inyan Kara Groups. These values are associated with high values for arsenic, selenium, and vanadium in samples from both groups. Anomalous values for these elements in the Graneros Group may be caused by bentonite beds contained in the rock units. As shown on the geochemical distribution plot, high uranium values that are located in the Inyan Kara Group are almost exclusively draining open-pit uranium mines.

28427 (GJBX—135(80)) **Death Valley 1° x 2° NTMS area, California and Nevada. Data report: National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1980. Contract AC13-76GJ01664. 311p. (DPST—79-146-16). NTIS, PC $17.60/MF $3.50.

Results of ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Death Valley 1° x 2° quadrangle are presented. Stream sediment samples were collected from small streams at 649 sites or at a nominal density of one site

per 20 square kilometers. Ground water samples were collected at 62 sites or at a nominal density of one site per 220 square kilometers. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water and surface water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Key data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) scintillometer readings, and (3) elemental analyses (U, Br, Cl, F, He, Mn, Na, and V). Supplementary data include site descriptors, tabulated analytical data for Al, Dy, and Mg, and histograms and cumulative frequency plots for all elements. Key data from stream sediment sites include (1) water quality measurements (2) important elemental analyses, (U, Th, Hf, Ce, Fe, Mn, Sc, Na, Ti, and V), and (3) scintillometer readings. Supplementary data from stream sediment sites include sample site descriptors (stream characteristics, vegetation, etc.), additional elemental analyses (Dy, Eu, La, Lu, Sm, and Yb), and histograms and cumulative frequency plots for all elements.

28428 (ORNL/EIS—121/V3) **Geological and geochemical aspects of uranium deposits. A selected, annotated bibliography.** Garland, P.A.; Thomas, J.M.; Brock, M.L.; Daniel, E.W. (comps.). (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A12/MF A01.

A bibliography of 479 references encompassing the fields of uranium and thorium geochemistry and mineralogy, geology of uranium deposits, uranium mining, and uranium exploration techniques has been compiled by the Ecological Sciences Information Center of Oak Ridge National Laboratory. The bibliography was produced for the National Uranium Resource Evaluation Program, which is funded by the Grand Junction Office of the Department of Energy. The references contained in the bibliography have been divided into the following eight subject categories: (1) geology of deposits, (2) geochemistry, (3) genesis O deposits, (4) exploration, (5) mineralogy, (6) uranium industry, (7) reserves and resources, and (8) geology of potential uranium-bearing areas. All categories specifically refer to uranium and thorium; the last category contains basic geologic information concerning areas which the Grand Junction Office feels are particularly favorable for uranium deposition. The references are indexed by author, geographic location, quadrangle name, geoformational feature, taxonomic name, and keyword.

28429 **Uranium logging in earth formations.** Givens, W.W. (to Mobil Oil Corp.). US Patent 4,180,729. 25 Dec 1979. Filed date 12 Jan 1978. 12p.

A technique is provided for assaying the formations surrounding a borehole for uranium. A borehole logging tool cyclically irradiates the formations with neutrons and responds to neutron fluxes produced during the period of time that prompt neutrons are being produced by the neutron fission of uranium in the formations. A borehole calibration tool employs a steady-state (continuous output) neutron source, firstly, to produce a response to neutron fluxes in models having known concentrations of uranium and, secondly, to to produce a response to neutron fluxes in the formations surrounding the borehole. The neutron flux responses of the borehole calibration tool in both the model and the formations surrounding the borehole are utilized to correct the neutron flux response of the borehole logging tool for the effects of epithermal/thermal neutron moderation, scattering, and absorption within the borehole itself.

FEED PROCESSING

28430 **Feasibility of extraction of uranium from seawater.** Campbell, M.H. (Exxon Nuclear Co., Inc., Richland, WA); Binney, S.E. *Trans. Am. Nucl. Soc.;* 33: 464-465(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ENRICHMENT

REFER ALSO TO CITATION(S) 28539

LASER EXCITATION

28431 **Beam splitter coupled CdSe optical parametric oscillator.** Levinos, N.J.; Arnold, G.P. (to Dept. of Energy). US Patent 189,652. 19 Feb 1980. Filed date 22 Aug 1977. 6p.

PAT-APPL-826,903.

An optical parametric oscillator is disclosed in which the resonant radiation is separated from the pump and output radiation so that it can be manipulated without interfering with them. Thus, for example, very narrow band output may readily be achieved by passing the resonant radiation through a line narrowing device which does not in itself interfere with either the pump radiation or the output radiation.

DEPLETED URANIUM

REFER ALSO TO CITATION(S) 29453

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 28544, 29341, 29377

28432 **Improved fuel pellet fabrication using gel microspheres.** Tiegs, S.M.; Haas, P.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 272-275(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 28477, 28533, 28534, 28535

28433 (DOE/ET/34036—T1) **Study of the potential uses of the Barnwell Nuclear Fuel Plant (BNFP). Final report.** (International Energy Associates Ltd., Washington, DC (USA)). 25 Mar 1980. Contract AC05-80ET34036. 302p. NTIS, PC A14/MF A01.

The purpose of this study is to provide an evaluation of possible international and domestic uses for the Barnwell Nuclear Fuel Plant, located in South Carolina, at the conclusion of the International Nuclear Fuel Cycle Evaluation. Four generic categories of use options for the Barnwell plant have been considered: storage of spent LWR fuel; reprocessing of LWR spent fuel; safeguards development and training; and non-use. Chapters are devoted to institutional options and integrated institutional-use options.

28434 (LA—8411-PR) **Evaluation of in-line nondestructive assay systems. Progress report, January 1-March 31, 1980.** Bowersox, D.F.; Ensslin, N.; Hsue, S.T.; Johnson, S.S.; Parker, J.L.; Sampson, T.E. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

Specified instruments for in-line nondestructive assay of streams of spent fuel processing will be tested under realistic conditions for use in effective process control and materials accounting. Progress in this project for January 1-March 31, 1980, is described.

28435 (ORNL/TM—7317) **Consolidated Fuel Reprocessing Program. Progress report, January 1-March 31, 1980.** Unger, W.E. (comp.). (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 75p. NTIS, PC A04/MF A01.

Progress is reported under the following headings: process R and D, engineering research (voloxidation, dissolution, feed preparation, solvent extraction, off-gas processing), engineering systems, technical support, and HTGR reprocessing. (DLC)

28436 **Process for the extraction of fission products.** Anav, M.; Chesne, A.; Leseur, A.; Miquel, P.; Pascard, R. (to Commissariat a l'Energie Atomique). US Patent 4,180,476. 25 Dec 1979. Priority date 30 Dec 1976, France, 8p.

A process is described for the extraction of fission products contained in irradiated nuclear fuel elements which have been subject to a temperature of at least 1200°C during their irradiation prior to dissolving the fuel by the wet process. After mechanically treating the elements in order to decan and/or cut them they are brought into contact with water in order to pass the fission products into aqueous solution. The treated elements are then separated from the thus obtained aqueous solution. At least one of the fission products is then recovered from the aqueous solution. The fission products are iodine, cesium, rubidium and tritium.

28437 **Advances in monitoring and control instrumentation for a purex solvent extraction system.** Browne, L.M.; Koski, O.H.; Bryan, G.H.; Wheelwright, E.J. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* 33: 467-468(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28438 **Dissolution process for advanced-PWR-type fuels.** Black, D.E.; Decker, L.A.; Pearson, L.G. (Exxon Nuclear Idaho, Idaho Falls). *Trans. Am. Nucl. Soc.;* 33: 468-469(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28439 Analytical procedure and training material development at ICPP. German, F.O. (Exxon Nuclear Idaho, Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 469-470(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 28476, 28487, 28529, 28530, 28536, 29049, 29063, 29450, 29451, 29452, 29453, 29454, 29456, 30048

28440 (CONF-780506—(Summ.)) **Packaging and transportation of radioactive materials: summary program.** (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 196p. NTIS, PC A09/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

This document contains summaries or abstracts of reports presented at the Symposium on Packaging and Transportation of Radioactive Materials. Separate indexing has been performed on individual items presented at this conference. (DC)

28441 (CONF-780506—(Vol.1)) **Packaging and transportation of radioactive materials.** (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 547p. NTIS, PC A23/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The presentations made at the Symposium on Packaging and Transportation of Radioactive Materials are included. The purpose of the meeting was for the interchange of information on the technology and politics of radioactive material transportation. Separate abstracts were prepared for individual items. (DC)

28442 (CONF-780506—(Vol.1), pp 3-7) **Vital line.** Cunningham, G.W. (Dept. of Energy, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The need for increased coordination in the transport of radioactive materials and the government's role in this area are discussed in this lecture. The development of a systems approach to standardize shipping casks' design and fabrication is needed. Industrial technology in these areas is appraised. Public acceptance of nuclear shipments or the safety of those shipments is also discussed. (DC)

28443 (CONF-780506—(Vol.1), pp 11-14) **Nuclear transportation: problems requiring attention and action.** Muntzing, L.M. (Doub, Purcell, Muntzing, and Hansen, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The current status of public acceptance of nuclear materials' transport in the USA is discussed. The nature of the concerns are related. State and federal constraints are presented and possible steps the governments can take to reduce the uncertainties are covered in this lecture. (DC)

28444 (CONF-780506—(Vol.1), pp 180-185) **Government's duty, as shipper and regulator, to keep spent fuel and waste on track: the ICC cases.** DiStefano, J. (Dept. of Energy, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The transportation of radioactive materials, particularly spent nuclear fuel and radioactive waste, is at once the most studied and the most misunderstood category of hazardous materials transportation. During recent years, agencies of the United States Government have expended substantial effort and money not only studying many aspects of nuclear materials transportation but also litigating the safety and economics of such transportation. The movement of such materials has been attacked, not only by some state and local organizations, but also, by senior members of the transportation industry - the nation's railroads. This paper will discuss the government's role in the litigation which has developed between the railroad industry on one side and the government and the nuclear industry on the other. For more than two years, the Department of Energy has joined with representatives of other government agencies and the nuclear industry in an effort to preserve the viability of rail transportation of radioactive materials under reasonable common carrier tariffs. The southern and western railroads had restricted such transportation by requiring spent fuel and radioactive waste to move only in special trains. The eastern railroads and some midwestern roads had refused any common carriage for these commodities. Because tariff rates or the absence of such rates sparked this controversy, the United States Interstate Commerce Commission became the tribunal to hear these cases in the first instance.The issues heard included the adequacy of current safety requirements including packaging, testing and insurance. By the end of 1977, the ICC had issued initial decisions striking down the restrictive tariffs and ordering publication of tariffs where none existed. The litigation, however, will not be finally concluded for some time.

28445 (CONF-780506—(Vol.1), pp 193-198) **Placing the special trains issue in perspective.** Rhoads, R.E. (Battelle Pacific Northwest Labs., Richland, WA); DeSteese, J.G.; Loscutoff, W.V.; Chais, M. 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The Association of American Railroads has proposed changes in the way railroads handle shipments of radioactive materials. These changes are embodied in a set of recommended operating practices that would require shipments of spent fuel and radioactive waste to be moved only in special train service. The proposed operating practices include a 35 mph maximum speed restriction, a passing restriction and a no-other freight restriction. Shippers of radioactive materials oppose the imposition of these operating practices. The special train issue is currently being argued in hearings before the Interstate Commerce Commission. The history and current status of these hearings are reviewed. Pacific Northwest Laboratories has undertaken a study to provide perspective on the safety and economic factors related to the use of special trains for shipping spent fuel. The results of this study for the amount of spent fuel anticipated to be shipped in 1986 are reviewed. The safety analysis determines the frequencies and severities of accidents for conventional freight trains and compares these to extrapolated frequencies and severities of accidents for conventional freight trains subject to the special train operating restrictions. Results of the study show that the adoption of special trains and attendant operating restrictions has limited potential for improving safety during shipment. The economic analysis compares the cost of spent fuel shipments made by special train and by conventional freight train service.Results of the economics phase of the study show that the use of special trains will most likely increase the cost of shipments by about 50%, although under certain circumstances shipping costs for spent fuel by special trains may be up to 20% lower than by conventional train service. Possible methods to resolve the special train issue are explored.

28446 (CONF-780506—(Vol.1), pp 251-261) **PARC (Plutonium Accident Resistant Container) project.** Andersen, J.A. (Sandia Labs., Albuquerque, NM). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Response by the US Nuclear Regulatory Commission (NRC) to a public law limiting the air transport of plutonium resulted in a new Qualification Criteria and led to the PARC project. The PARC project resulted in the design, development, and certification testing of a crashworthy air transportable radioactive materials package for certification by the NRC. This package, identified by the NRC as the Model PAT-1 Package (PAT = Plutonium Air Transportable), has a mass capacity of 2 kg of PuO_2 and a thermal capacity of 25 watts; the internal volume of the inner containment vessel is 1460 cm^3; the package dimensions are 62 cm (24 - 1/2 in.) O.D. x 108 cm (42 - 1/2 in.) length and a mass of 227 kg (500 lbs). The design rationale for very high energy absorption (impact, crush, puncture, and slash protection) with residual high-level fire protection, resulted in a reasonably small air-transportable package, advancing the packaging state-of-the-art. Optimization design interactions were utilized in the areas of impact energy absorption and stress and thermal analysis. Package test results are presented in relation to the containment acceptance criteria of the Qualification Criteria and ANSI N 14.5 leaktight standards and the IAEA Safety Series No. 6 A2 radioactive material release quantities. Acceptability of the pre-accident and post-accident package configuration with respect to shielding and criticality standards are ascertained.

28447 (CONF-780506—(Vol.1) pp 287-294) **Study of plutonia leak rates from simulated container leaks.** Drennen, D.C.; Schmidt, E.W.; Madia, W.J.; Pobereskin, M. (Battelle Columbus Labs., OH). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

In cooperation with Battelle's Northwest Laboratory, Battelle-Columbus is conducting an experimental program to study the leak rate of plutonia (PuO_2) from simulated leaks in shipping containers. The objective of this program is to correlate the plutonia particulate leak rate with the helium gas leak rate from various types of cracks under a range of experimental conditions. The data from this study will provide a basis for establishing criteria and standards for leak tightness of plutonia shipping containers. Leaks through a small orifice (5 to 20-μm diameter) in a thin disk were investigated. The effects on the leak rate of orifice size, internal gas pressure, position, and agitation were studied. In addition to the mass leak rate, the size distribution of the emitted particulates was analyzed. Initially, bench-top simulant experiments using thoria (ThO_2) powder (average particle size of 2 μm) were conducted in order to check out measurement techniques and the system's adaptability to

glove box operations. The next phase of the program involved hot experiments using plutonia powder (average particle size of 2 μm) to determine the leak rate correlation under the various experimental conditions. Data were collected to demonstrate the parametric effects and provide a basis for realistically assessing the He gas/PuO_2 particulate leak correlation. With some exceptions, it was observed that the particulate leak rate increased with orifice size, internal gas pressure, and vibration. Average emission was greatest, in most instances, when the leak was in the down position.The ratio of He gas leak rate to plutonia particulate leak rate, on an atom to molecular basis, ranged from 10^3 to 10^4. The mean particle size distribution of the leaked particles increased with increasing orifice diameter.

28448 (CONF-780506—(Vol.1), pp 351-358) **Puncture phenomena in low velocity impact of radioactive waste shipping containers.** Little, R.W. (Michigan State Univ., East Lansing); Larder, R.A. 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Punch penetration phenomena of a radioactive waste shipping container when subjected to low velocity impact are studied both analytically and experimentally. Model cask materials in the form of circular test samples of stainless steel, backed with high density material (lead or uranium) are dropped on a steel punch with impact velocities of 220 in/sec or less. The experimental program involves 25 static tests and 67 dynamic tests in which plate thicknesses, backing material and punch diameters are varied. A detailed finite element analysis including the effects of plastic-work hardening in the materials and plate laminate separation was made on two geometries; ballasted with an impact velocity of 66.7 in/sec and unballasted with an impact velocity of 200 in/sec. An alternate analytical program was developed based upon a system frequency spectra analysis. A Rayleigh-Ritz approach was selected, including the laminated plates, deformable punch and elastic ballast in the potential energy, and distributed mass in the kinetic energy. A model analysis using the first five frequencies was performed and stress calculations included the effects of plastic deformation. Excellent agreement was obtained between the Rayleigh-Ritz and the finite element analyses. In most cases, it was observed that initial impact was not sufficient to cause onset of punch yield or plate puncture but the plate vibration effects would initiate failure at a later time. The Rayleigh-Ritz program was used to analyze the different experimental configurations and then compared to experimental data. This research indicates that low velocity impact studies of radioactive waste shipping containers must consider the phenomena of structural vibrations. The analytical approach developed offers an accurate, quick and inexpensive method of examining low velocity impact.

28449 (CONF-780506—(Vol.1), pp 375-383) **Correlation of experimental shipping cask model structural behavior by computer analysis.** Balmert, M.; Groom, J. (Battelle Columbus Labs., OH). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

As an aid in the planning and investigation of an experimental research program on the effects of environmental accidents upon spent fuel shipping containers, a study is being made to correlate the results of tests of scale model shipping casks with those of complex structural computer models. After surveying the available codes, a general purpose, dynamic, nonlinear computer program (ADINA) was chosen to model several experiments. Among these are: stainless steel cylindrical containers dropped on end from a height of 12 inches; lead and uranium filled cask models dropped 12 inches and 30 feet, in both end and side orientations. The results will be used for selection of the test parameters by the prediction and planning of failure test conditions, as well as confirmation of previous test results. Together, the experimental and theoretical analyses will provide a realistic assessment of the effects of accident loadings on spent fuel shipping containers.

28450 (CONF-780506—(Vol.2)) **Packaging and transportation of radioactive materials.** (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 519p. NTIS, PC A22/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The following topics are discussed in this volume: shielding and criticality; transportation accidents; physical security in transit; transport forecasting and logistics; transportation experience, operations and planning; regulation; standards and quality assurance; risk analysis; and environmental impacts. Separate abstracts are prepared for individual items. (DC)

28451 (CONF-780506—(Vol.2), pp 602-611) **Safe transportation of radioactive material shipping containers including accident and response experience.** Taylor, J.C. (Union Carbide Corp., Paducah, KY). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The safe transportation of radioactive material shipping containers requires the expertise of knowledgeable and concerned people. When accidents occur involving the transportation of these radioactive material shipping containers, prompt and efficient response to the needs of the accident situation by competent personnel is mandatory in order to minimize the hazards to which the general public might be exposed. This paper describes the emergency response and retrieval activities exercised following accidents which occurred during the transportation of three types of radioactive material shipping containers by three different modes of transportation: namely - motor freight, rail freight, and trailer on flat car (TOFC) service. There was no leakage or loss of material as the result of the accidents, nor was there any loss of life or injury to any persons in or near the accident sites.

28452 (CONF-780506—(Vol.2), pp 612-614) **Uranium hexafluoride cylinders survive train derailment.** Teer, B.R. (Transnuclear, Inc., White Plains, NY). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

A serious train derailment took place in North Carolina in March of 1977. Two of the twenty-nine cars which went off the tracks carried radioactive materials in the form of natural uranium hexafluoride - UF_6(N). The packaging for this low specific activity material is a 48 inch diameter by 12.5 foot long cylinder constructed of 5/8 inch thick steel. Each of the four cylinders contained approximately 12,500 kg of UF_6(N). The cylinders were mounted on steel cradles which were securely fastened to trailers which in turn were riding on flatcars in standard piggyback fashion. All four of the trailers and cylinders were damaged. The condition of each cylinder immediately after the accident, the recovery and subsequent shipment to Oak Ridge, the receipt inspection and the final disposition of the cylinders and the contents are described in the paper. The immediate response of the media to the news that radioactive material was on the train resulted in a great deal of misinformation being disseminated. In contrast to the initial reports of leakage, there was no breach of the containers and no radioactive contamination of any kind. The National Transportation Safety Board has issued a report on the accident recommending development of guidelines for emergency response procedures.

28453 (CONF-780506—(Vol.2), pp 683-692) **Worldwide spent fuel transportation logistics.** Best, R.E. (Nuclear Assurance Corp., Atlanta, GA); Garrison, R.F. 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

This paper presents an overview of the worldwide transportation requirements for spent fuel. Included are estimates of numbers and types of shipments by mode and cask type for 1985 and the year 2000. In addition, projected capital and transportation costs are presented. For the year 1977 and prior years inclusive, there is a cumulative worldwide requirement for approximately 300 MTU of spent fuel storage at away-from-reactor (AFR) facilities. The cumulative requirements for years through 1985 are projected to be nearly 10,000 MTU, and for the years through 2000 the requirements are conservatively expected to exceed 60,000 MTU. These AFR requirements may be related directly to spent fuel transportation requirements. In total nearly 77,000 total cask shipments of spent fuel will be required between 1977 and 2000. These shipments will include truck, rail, and intermodal moves with many ocean and coastal water shipments. A limited number of shipments by air may also occur. The US fraction of these is expected to include 39,000 truck shipments and 14,000 rail shipments. European shipments to regional facilities are expected to be primarily by rail or water mode and are projected to account for 16,000 moves. Pacific basin shipments will account for 4500 moves. The remaining are from other regions. Over 400 casks will be needed to meet the transportation demands. Capital investment is expected to reach $800,000,000 in 1977 dollars. Cumulative transport costs will be a staggering $4.4 billion dollars.

28454 (CONF-780506—(Vol.2), pp 763-774) **DOE program for transportation R and D: a progress report.** Sisler, J.A. (Dept. of Energy, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The Transportation Branch of the Division of Environmental Control Technology (ECT), US Department of Energy (DOE), is managing a research and development program oriented toward the environmental and safety aspects of the transportation of energy materials. This program was started under the US Energy Research and Development Administration (ERDA), and in October 1977 became one of the programs of the newly formed DOE. The objectives of the current R and D program include: (1) development of data and methodology for environment and safety (E and S) assessments including development of transportation environmental data, severe accident analysis and risk assessment; (2) confirmatory full-scale testing of package and vehicular systems to improve scale modeling and analytical techniques for transport system safety assessment; (3) development of an improved capability for assessing the dynamic performance of nuclear packaging under severe acci-

dent conditions; (4) evaluation and verification of existing transportation standards to assure adequate environmental controls; and (5) development of the needed information system tools such as films, booklets, and exhibits to permit the public and other interested parties to have access to the results of the R and D program. This paper summarizes the history of this program, describes the accomplishments, includes references to published reports, and discusses the current status of the environmental and safety R and D program as related to transportation of energy material. Comments are also included regarding the future direction of the program.

28455 (CONF-780506—(Vol.2), pp 783-789) **Identification and prioritization of potential problems in nuclear material transportation, now through 2000.** DeSteese, J.G.; Rhoads, R.E. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

This review presents the results of issue analysis used to identify potential problems which may impact the transportation of nuclear fuel cycle materials between now and 2000. An objective of this effort is to provide advanced warning of potential problems which may inhibit the future development of safe and environmentally acceptable nuclear material transportation systems. Issue analysis was also used to establish the priorities of potential problems. This provides a basis for recommending research, development and other necessary action to address the potentially adverse effects of these problems. Over 100 problem issues were identified in workshop sessions and represent the combined opinions of transportation experts in industry, government and research institutions. A panel ranked potential impact and immediacy of the problem issues on a scale of 1 to 5. The product of the impact and immediacy ranking was taken to indicate relative importance. The type of potential problem identified as most important has consequences which may impose unnecessarily severe or costly restrictions on nuclear material transportation. Ten specific high priority potential problems are discussed which collectively may result in a future inadequacy of transportation for spent fuel and waste materials. These problems may become critical in the next decade. Recommendations are made for new effort that addresses the solution of these problems. A brief review is included of some potential problems judged to be currently of low priority, but which may become more significant toward the end of the century.

28456 (CONF-780506—(Vol.2), pp 809-819) **Recent developments in the regulation of nuclear transportation.** Grella, A.W. (Dept. of Transportation, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

In the past four years, almost all nations and international or intergovernmental transport organizations have effected transitions from the 1967 to 1973 IAEA standards as their basis for regulatory requirements for the safe transport of radioactive materials. One major exception to this transition is the USA itself, where this transition has not yet taken place. Major amendments to revise 49 CFR Parts 100-199 of the Department of Transportation regulations and 10 CFR Part 71 of the Nuclear Regulatory Commission regulations are required to effect this transition. The notices of proposed rulemaking to effect this transition in the USA are expected to be published by DOT and NRC concurrently sometime in 1978. Final amendments can be expected later, after the public comment period on the notices and considerations of those comments. This paper summarizes the status of current thinking on US adoption of the 1973 IAEA standards, as well as the status of adoption of those standards by international intergovernmental organizations, such as the Intergovernmental Maritime Consultative Organization, International Civil Aviation Organization, etc. A number of the differences between the expected US regulations and other regulations based on the 1973 IAEA standards are explained. This paper also discusses a number of other events or matters which have been taking place in the US in the past four years which have or may have an effect on transport of nuclear materials and its regulation, including air transport of plutonium, rail transport of spent fuel and other regulations by state or political subdivisions. The paper also discusses changes to US regulations accomplished in the past four years, which are not related to 1973 IAEA standards, as well as some other possible areas where regulatory proposals might be anticipated, such as control of radiation exposures to certain transport workers and other matters.

28457 (CONF-780506—(Vol.2), pp 831-836) **5 R's of hazardous materials transportation.** Lamb, J.A. (Dept. of Energy, Oak Ridge, TN); Blalock, L.G.; Brooks, G.B. 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

In recent years several states, municipalities, and carriers have adopted rules and regulations implementing the hazardous materials regulations of the Department of Transportation. In many instances, the implementation is more stringent and restrictive than the Federal regulations; consequently, shippers and carriers alike are experiencing problems in complying with a myriad of rules, regulations and procedures. This paper will examine those regulations and rules which have been adopted or are being considered for adoption by state and local regulatory bodies, carriers, and carrier associations; the restrictions, ramifications, and results of these actions on intra and inter state transportation of hazardous materials; and a discussion of possible remedies that are available to shippers. Specifically, these discussions will be directed primarily to the transportation of radioactive materials while recognizing that regulatory constraints affect all hazardous materials commerce to some degree. Collectively, the growth of the nuclear industry; the energy crisis and the related conservation efforts; and the continuing concern on the part of the general public, environmentalists and special interest groups about the alleged lack of control of hazardous material transport will also be examined in terms of the far-reaching effects on the nation's transportation system.

28458 (CONF-780506—(Vol.2), pp 939-945) **Transportation of postfission radioactive wastes from the commercial LWR fuel cycle.** Murphy, E.S.; Clark, L.L.; Napier, B.A. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Requirements for transportation of postfission radioactive wastes from the commercial LWR fuel cycle were studied. Only radioactive wastes that would require transport to federal facilities for interim storage or final disposal were considered. These wastes included spent fuel, solidified high-level waste, fuel residues and non-high-level TRU waste. Transportation requirements were determined and transport facilities described; packaging and shipping costs were estimated; and the potential environmental impacts of transportation and of postulated accidents were evaluated. Projections are given for the number one cost of waste shipments for the once-through fuel cycle and for a uranium plus plutonium recycle option. The projections are based on an assumed nuclear generating capacity of 400 GWe in the year 2000. On a cost per kg of heavy metal basis, truck cask shipments appear to cost about the same as rail cask shipments. However, shipping cost estimates do not take into account the large increase in cask handling capacity required if all shipments were by truck. It is therefore assumed that cask shipments will be by rail. Under normal transport conditions, no radioactive materials will be released from shipping containers to the atmosphere, ground or water. Direct radiation doses calculated for members of the general population from passing rail or truck shipments of radioactive wastes are insignificant when compared to doses from natural background radiation. In the absence of accident data involving material releases, a series of minor, moderate and severe accident scenarios for radioactive shipments were postulated. Expected frequencies for these accidents were calculated on the basis of accident statistics and assumed total shipment miles; material releases were postulated for each accident scenario; and radiation doses from these postulated releases were calculated.

28459 DOE transportation technology center; a program for nuclear transportation. Jefferson, R.M. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 450(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28460 Contact- handled transuranic waste transportation. Freedman, J.M.; Sutherland, S.H.; Eakes, R.G. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 450-451(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28461 ORNL Nuclear Legislative Data Base Program. Heiskell, M.M. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 451-452(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28462 ORNL interface and logistics studies. Marshall, J.R.; Joy, D.S.; Hudson, B.J. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 452-453(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28463 Application of ALARA principles to shipment of spent nuclear fuel. Greenborg, J.; Brackenbush, L.W.; Murphy, D.W.; Burnett, R.A.; Lewis, J.R. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 453-454(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28464 SABRES II: a combat simulation model for nuclear materials transportation protection. De Laquil III, P. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 454-456(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 28548

28465 (PNL—3000-5) **Nuclear waste management. Quarterly progress report, January-March 1980.** Platt, A.M.; Powell, J.A. (comps.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 107p. NTIS, PC A06/MF A01.

Reported are: high-level waste immobilization, alternative waste forms, nuclear waste materials characterization, TRU waste immobilization, TRU waste decontamination, krypton solidification, thermal outgassing, iodine-129 fixation, unsaturated zone transport, well-logging instrumentation development, mobile organic complexes of fission products, waste management system and safety studies, assessment of effectiveness of geologic isolation systems, waste/rock interactions, engineered barriers, criteria for defining waste isolation, and spent fuel and pool component integrity. (DLC)

WASTE PROCESSING

REFER ALSO TO CITATION(S) 28439, 28525, 28526, 29628

28466 **Method of handling radioactive alkali metal waste.** Wolson, R.D.; McPheeters, C.C. US Patent Application 043,855. [nd]. 21p.

Radioactive alkali metal is mixed with particulate silica in a rotary drum reactor in which the alkali metal is converted to the monoxide during rotation of the reactor to produce particulate silica coated with the alkali metal monoxide suitable as a feed material to make a glass for storing radioactive material. Silica particles, the majority of which pass through a 95 mesh screen or preferably through a 200 mesh screen, are employed in this process, and the preferred weight ratio of silica to alkali metal is 7 to 1 in order to produce a feed material for the final glass product having a silica to alkali metal monoxide ratio of about 5 to 1.

28467 **Electric controlled air incinerator for radioactive wastes.** Warren, J.H.; Hootman, H.E. US Patent Application 058,420. [nd]. 15p.

A two-stage incinerator is provided which includes a primary combustion chamber and an afterburner chamber for offgases. The latter is formed by a plurality of vertical tubes in combination with associated manifolds which connect the tubes together to form a continuous tortuous path. Electrically-controlled heaters surround the tubes while electrically controlled plate heaters heat the manifolds. A gravity-type ash removal system is located at the bottom of the first afterburner tube while an air mixer is disposed in that same tube just above the outlet from the primary chamber. A ram injector in combination with rotary magazine feeds waste to a horizontal tube forming the primary combustion chamber.

28468 (DP-MS—80-25) **High-level nuclear waste immobilization program.** Gordon, D.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 18p. (CONF-800244—1). NTIS, PC A02/MF A01.

From ASME, IEEE, and Society of Professional Engineer Joint meeting; New London, CT, USA (19 Feb 1980).

Existing high-level nuclear wastes in the United States are described along with current management techniques and long-term disposal options. All of the disposal options involve some type of immobilization operation to restrict radio-nuclide dispersion; the primary option is disposal of immobilized waste packages in deep (500-1000 meter) geological formations. Several immobilized waste forms currently under development are discussed, and form selection factors and regulatory criteria are identified.

28469 (ENICO—1037) **Comparison of HEPA filter test methods in corrosive environments.** Murphy, L.P.; Fernandez, S.J.; Motes, B.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Jul 1980. Contract AC07-79ID01675. 31p. NTIS, PC A03/MF A01.

An evaluation of the three HEPA filter test methods in corrosive environments was conducted: the dioctyl phthalate (DOP) method (US Standard Method ANSI N-101.1-1972), the sodium chloride method (British Standard 3928:1969), and the soda-fluorescein or uranine method (French Standard AFNOR STD NFX 44-011). The effects of humidity, temperature and oxides of nitrogen (NO/sub x/) on each method was examined. The experimental design used in the evaluation measured and separated both the effect of each variable and any interaction between variables on the test method. Recommendations for changes in the standard methods to reduce erratic online results are presented.

28470 (GEFR-SP—215) **Actinide recycle in LMFBRs as a waste management alternative.** Beaman, S.L. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 30 Apr 1980. Contract AM03-76SF00893. 33p. (CONF-800743—2). NTIS, PC A03/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

A strategy of actinide burnup in LMFBRs has been investigated as a waste management alternative to long-term storage of high level nuclear waste. This strategy has been evaluated because many of the actinides in the waste from spent-fuel reprocessing have half-lives of thousands of years and an alternative to geological storage may be desired. By burning the actinides in LMFBRs the long-lived isotopes can be effectively transmuted to fission products which have significantly shorter half-lives. Actinide burnup in LMFBRs rather than LWRs is preferred because the fission to capture reaction rate ratios are higher in the LMFBR, and the LMFBR performance is not highly sensitive to the addition of the actinide waste material. An actinide target assembly recycle scheme has been analyzed to determine the effects of the actinides on the LMFBR performance, including local power peaking, breeding ratio, and fissile material requirements. The overall efficiency of actinide burnout in LMFBRs has been evaluated, and equilibrium cycle conditions have been determined. The results of the actinide recycle study indicate that the actinide wastes produced by a fission reactor economy could be transmuted in fast reactors with only a two percent penalty in the fissile loading requirements and a one to two percent penalty in the breeding ratio of the host reactors. The actinide target assemblies could be tailored to give a power distribution which is comparable to that of the standard fuel assemblies. However, the total shutdown decay heat from a target assembly would be approximately 43 percent greater than that from a standard assembly.

28471 (HEDL-SA—2009-FP) **Remotely operated organic liquid waste incinerator for the fuels and materials examination facility.** Sales, W.L.; Barker, R.E.; Hershey, R.B. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 12p. (CONF-800607—66). NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The search for a practical method for the disposal of small quantities of oraganic liquid waste, a waste product of metallographic sample preparation at the Fuels and Materials Examination Facility has led to the design of an incinerator/off-gas system to burn organic liquid wastes and selected organic solids. The incinerator is to be installed in a shielded inert-atmosphere cell, and will be remotely operated and maintained. The off-gas system is a wet-scrubber and filter system designed to release particulate-free off-gas to the FMEF Building Exhaust System.

28472 (MLM—2713) **Commercial cyclone incinerator demonstration program: October 1979-March 1980.** Alexander, B.M. (Mound Facility, Miamisburg, OH (USA)). 21 May 1980. Contract AC04-76DP00053. 15p. NTIS, PC A02/MF A01.

The commercial cyclone incinerator program was designed to study the effects of burning low-level waste contaminated with beta and gamma emitters in a cyclone system. The ultimate program goal is the demonstration of a cyclone incinerator at a nuclear power plant. During the past six months, progress was made toward achieving the second program objective, Complete Incinerator Feasibility Plan. Forty-one laboratory-scale experiments were completed, with five more experiments remaining to be performed. Sample analysis from completed experiments continues. A promising scrub liquor was identified and is now being used for improved absorption of iodide and chloride from incinerator offgas. Inconel 601 continues to perform well as the material of construction for the laboratory-scale burn chamber.

28473 (MLM—2735) **Development of ultrafiltration and adsorbents: October 1979-March 1980.** Roberts, R.C.; Colvin, C.M. (Mound Facility, Miamisburg, OH (USA)). 2 Jul 1980. Contract AC04-76DP00053. 18p. NTIS, PC A02/MF A01.

Tests on a sample of trench water from the Maxey Flats burial ground effectively demonstrated the new Reverse Osmosis Pilot Plant. The effluent from the 50% salt-rejection membrane was decontaminated well enough with the exception of tritium to be discharged to the environment. The performance of the 97% salt-rejection membrane was superior to that of the 50% membrane. A breakthrough and capacity experiment was conducted with Durasil 10 on a simulated Three Mile Island solution. The maximum decontamination factor was extrapolated to be 10^6, which would reduce the cesium level of TMI water to below the discard limit. Capacity ($1/DF = 0.5$) was reached at 1260 column volumes. Several adsorbents were tested in the engineering columns for decontamination of cesium-bearing solutions. Under the conditions of the experiment, these adsorbents were ineffective in removing cesium from the solution.

28474 (PNL—3244) **Preliminary evaluation of alternative waste form solidification processes. Volume I. Identification of the processes.** Treat, R.L.; Nesbitt, J.F.; Blair, H.T.; Carter, J.G.; Gorton, P.S.; Partain, W.L.; Timmerman, C.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1980. Contract AC06-76RL01830. 535p. NTIS, PC A23/MF A01.

This document contains preconceptual design data on 11 processes for the solidification and isolation of nuclear high-level liquid wastes (HLLW). The processes are: in-can glass melting (ICGM) process, joule-heated glass melting (JHGM) process, glass-ceramic (GC) process, marbles-in-lead (MIL) matrix process, supercalcine pellets-in-metal (SCPIM) matrix process, pyrolytic-carbon coated pellets-in-metal (PCCPIM) matrix process, supercalcine hot-isostatic-pressing (SCHIP) process, SYNROC hot-isostatic-pressing (SYNROC HIP) process, titanate process, concrete process, and cermet process. For the purposes of this study, it was assumed that each of the solidification processes is capable of handling similar amounts of HLLW generated in a production-sized fuel reprocessing plant. It was also assumed that each of the processes would be enclosed in a shielded canyon or cells within a waste facility located at the fuel reprocessing plant. Finally, it was assumed that all of the processes would be subject to the same set of regulations, codes and standards. Each of the solidification processes converts waste into forms that may be acceptable for geological disposal. Each process begins with the receipt of HLLW from the fuel reprocessing plant. In this study, it was assumed that the original composition of the HLLW would be the same for each process. The process ends when the different waste forms are enclosed in canisters or containers that are acceptable for interim storage. Overviews of each of the 11 processes and the bases used for their identification are presented in the first part of this report. Each process, including its equipment and its requirements, is covered in more detail in Appendices A through K. Pertinent information on the current state of the art and the research and development required for the implementation of each process are also noted in the appendices.

28475 **Recovery of palladium and technetium values.** Horwitz, E.P.; Delphin, W.H. (to Department of Energy, Washington, DC (USA)). British Patent 2,011,696/A/. 11 Jul 1979. 3p.

A method is described for recovering palladium and technetium values from nuclear fuel reprocessing waste solutions containing these and other values by contracting the waste solution with an extractant of tricaprylmethylammonium nitrate in an inert hydrocarbon diluent which extracts the palladium and technetium values from the waste solution. The palladium and technetium values are recovered from the extractant and from any other coextracted values with a strong acid strip solution.

28476 (UCRL—15253) **Transuranic contaminated waste container characterization and data base. Revision I.** Kniazewycz, B.G. (TERA Advanced Services Corp., Berkeley, CA (USA)). May 1980. Contract W-7405-ENG-48. 330p. NTIS, PC A15/MF A01.

The Nuclear Regulatory Commission (NRC) is developing regulations governing the management, handling and disposal of transuranium (TRU) radioisotope contaminated wastes as part of the NRC's overall waste management program. In the development of such regulations, numerous subtasks have been identified which require completion before meaningful regulations can be proposed, their impact evaluated and the regulations implemented. This report was prepared to assist in the development of the technical data base necessary to support rule-making actions dealing with TRU-contaminated wastes. An earlier report presented the waste sources, characteristics and inventory of both Department of Energy (DOE) generated and commercially generated TRU waste. In this report a wide variety of waste sources as well as a large TRU inventory were identified. The purpose of this report is to identify the different packaging systems used and proposed for TRU waste and to document their characteristics. This document then serves as part of the data base necessary to complete preparation and initiate implementation of TRU waste container and packaging standards and criteria suitable for inclusion in the present TRU waste management program. It is the purpose of this report to serve as a working document which will be used as appropriate in the TRU Waste Management Program. This report, and those following, will be compatible not only in format, but also in reference material and direction.

28477 (LA-tr—80-17) **Recovery, purification, and concentration of plutonium and americium from the aqueous wastes discharged in the reprocessing studies.** Tsujino, T.; Hoshino, T.; Yasu, S.; Kawashima, Y. (Japan Atomic Energy Research Inst., Tokyo). May 1980. Translation of JAERI-M—6106, April 1975. 50p. NTIS, PC A03/MF A01.

A standard procedure has been established for use in the laboratory where plutonium and americium, from the aqueous wastes occurring in process studies on reprocessing, are recovered and purified through preliminary tests of the precipitation as hydroxides and the anion exchange in nitrate media. The procedure was proven in the treatment of actual process wastes, of which the results were contributed to determine the process conditions in the plutonium purification and product concentration of the JAERI Reprocessing Test Plant. The preliminary tests also include washing of U and Am recovery from the anion-exchanger in nitrate media, direct ion-exchange recovery of Pu from the TBP phase and elution of Am from the cation-exchanger.

28478 **Recovery of actinide values.** Horwitz, E.P.; Delphin, W.H.; Mason, G.W. (to Department of Energy, Washington, DC (USA)). British Patent 2,011,697/A/. 11 Jul 1979. 8p.

A process is described for partitioning and recovering actinide values from acidic waste solutions resulting from reprocessing of irradiated nuclear fuels by adding hydroxylammonium nitrate and hydrazine to the waste solution to adjust the valence of the neptunium and plutonium values in the solution to the +4 oxidation state, thus forming a feed solution and contacting the feed solution with an extractant of di-hexoxyethyl phosphoric acid in an organic diluent whereby the actinide values, most of the rare earth values and some fission product values are taken up by the extractant. Separation is achieved by contacting the loaded extractant with two aqueous strip solutions, a nitric acid solution to selectively strip the americium, curium and rare earth values and an oxalate solution of tetramethylammonium hydrogen oxalate and oxalic acid or trimethylammonium hydrogen oxalate to selectively strip the neptunium, plutonium and fission product values. Uranium values remain in the extractant and may be recovered with a phosphoric acid strip. The neptunium and plutonium values are recovered from the oxalate by adding sufficient nitric acid to destroy the complexing ability of the oxalate, forming a second feed, and contacting the second feed with a second extractant of tricaprylmethylammonium nitrate in an inert diluent whereby the neptunium and plutonium values are selectively extracted. The values are recovered from the extractant with formic acid.

28479 **Off-gas treatment system for INEL radioactive slagging pyrolysis incinerator.** Christian, J.D.; Choi, E.C.; Cox, N.D.; Haff, K.W.; Hootman, H.E.; Ziegler, D.L. *Trans. Am. Nucl. Soc.;* **33**: 410(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28480 **Analysis of radionuclides in the defense waste processing facility.** Chandler, J.R.; Finch, D.R.; Becker, G.W. (Savannah River Lab., Aiken, SC). *Trans. Am. Nucl. Soc.;* **33**: 415-416(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28481 **In situ nondestructive plutonium assay for an electropolishing bath.** Close, D.A.; Booth, T.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 423-425(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28482 **Chemical decontamination of metals.** Partridge, J.A.; Lerch, R.E. (Hanford Engineering Development Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 430-431(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28483 **Strategy analysis for ^{85}Kr waste management.** Knecht, D.A.; Brown, R.A. (Exxon Nuclear Idaho, Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 431-433(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28484 **Direct denitration of plutonium nitrate-nitric acid solution in a screw calciner.** Bryan, G.H.; Wheelwright, E.J.; Browne, L.M. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 468(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28485 **Glass: an available material for the immobilization of nuclear waste.** Mendel, J.E. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 278(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 28470, 28483, 28514, 28516, 28519, 28527, 29763

28486 **Material for radioactive protection.** Taylor, R.S.; Boyer, N.W. US Patent Application 003,840. [nd]. 13p.

A boron containing burn resistant, low-level radiation protection material useful, for example, as a liner for radioactive waste disposal and storage, a component for neutron absorber, and a shield for a neutron source is described. The material is basically composed of borax in the range of 25 to 50%, coal tar in the range of 25 to

37.5%, with the remainder being an epoxy resin mix. A preferred composition is 50% borax, 25% coal tar and 25% epoxy resin. The material is not susceptible to burning and is about 1/5 the cost of existing radiation protection material utilized in similar applications.

28487 (HEDL-SA—2055) **Remote characterization of spent LWR fuel for geologic disposal demonstrations.** Davis, R.B.; Fish, R.L.; Pasupathi, V.; Stellrecht, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 20p. (CONF-800607—78). NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

State-of-the-art hot cell examination techniques are being used to evaluate spent fuel performance during exposure to simulated geologic repository environments. Forty-five pressurized light water reactor fuel rods were examined prior to emplacement in geologic disposal tests. Sufficient data were collected on both cladding and fuel to provide a basis, along with post-test examination data, for assessing the ability of the spent fuel to retain radionuclides.

28488 (LBL—10517) **Rock properties and their effect on thermally-induced displacements and stresses.** Chan, T.; Hood, M.; Board, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering; Terra Tek, Inc., Salt Lake City, UT (USA)). Feb 1980. Contract W-7405-ENG-48. 22p. (CONF-800204—10). NTIS, PC A02/MF A01.

From Energy-sources technology conference; New Orleans, LA, USA (3 Feb 1980).

A discussion is given of the importance of material properties in the finite-element calculations for thermally induced displacements and stresses resulting from a heating experiment in an in-situ granitic rock, at Stripa, Sweden. Comparisons are made between field measurements and finite element method calculations using (1) temperature independent, (2) temperature dependent thermal and thermomechanical properties and (3) in-situ and laboratory measurements for Young's modulus. The calculations of rock displacements are influenced predominantly by the temperature dependence of the thermal expansion coefficient, whereas the dominant factor affecting predictions for rock stresses is the in-situ modulus.

28489 (ONWI—98) **Proceedings of a workshop on thermomechanical modeling for a hardrock waste repository.** Holzer, F.; Ramspott, L. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 138p. (UCAR—10043; CONF-790683—(Summ.)). NTIS, PC A07/MF A01.

From ONWI-LLL workshop on thermomechanical modeling for a hard rock repository; Berkeley, CA, USA (25 Jun 1979).

These proceedings summarize the discussions, conclusions, and recommendations reached in a workshop on Thermomechanical Modeling for a Radioactive Waste Respository in hard crystalline rock from June 25-27, 1979, in Berkeley, California. The workshop was arranged and chaired by the Lawrence Livermore Laboratory under the sponsorship of the Office of Nuclear Waste Isolation and the DOE. About 100 participants from national laboratories, universities, private companies, and government organizations spent 2-1/2 days exchanging information and developing a set of conclusions and recommendations. The objectives of the workshop were as follows: (1) identify the key issues connected with modeling and validating the response of a hard rock respository to the emplaced waste source; and (2) identify status and develop a list of recommended activities, in order of priority, which would serve as programmatic input to ONWI and DOE for future consideration and implementation. Discussions covered modeling and calculations, laboratory and field measurements of properties and effects, instruments and techniques, and field experimentation for validation and model testing. Emphasis was placed on the thermomechanical response of the rock to the radioactive waste source emplaced within it. Hydrologic and radionuclide transport properties were specifically excluded, because they were to be the subject of a subsequent workshop.

28490 (PNL—2858) **Hydrogeologic effects of natural disruptive events on nuclear waste repositories.** Davis, S.N. (Arizona Univ., Tucson (USA)). Jun 1980. Contract AC06-76RL01830. 41p. NTIS, PC A03/MF A01.

Some possible hydrogeologic effects of disruptive events that may affect repositories for nuclear wastte are described. A very large number of combinations of natural events can be imagined, but only those events which are judged to be most probable are covered. Waste-induced effects are not considered. The disruptive events discussed above are placed into four geologic settings. Although the geology is not specific to given repository sites that have been considered by other agencies, the geology has been generalized from actual field data and is, therefore, considered to be physically reasonable. The geologic settings considered are: (1) interior salt domes of the Gulf Coast, (2) bedded salt of southeastern New Mexico, (3) argillaceous rocks of southern Nevanda, and (4) granitic stocks of the Basin and Range Province. Log-normal distributions of permeabilities of rock units are given for each region. Chapters are devoted to: poresity and permeability of natural materials, regional flow patterns, disruptive events (faulting, dissolution of rock forming minerals, fracturing from various causes, rapid changes of hydraulic regimen); possible hydrologic effects of disruptive events; and hydraulic fracturing.

28491 (PNL—2928) **Assessment of effectiveness of geologic isolation systems. Perspectives on the geological and hydrological aspects of long-term release scenario analyses.** Stottlemyre, J.A.; Wallace, R.W.; Benson, G.L.; Zellmer, J.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 123p. NTIS, PC A06/MF A01.

Information that may be relevant to individuals involved with analyzing long-term release scenarios of specific repositories for nuclear waste is presented. The bulk of the information is derived from recent studies in West Germany and the United States. Emphasis is on the specific geological and hydrological phenomena that, alone or in concert, could potentially perturb the area around specific repository sites. Research is continuing on most of the topics discussed within this report. Because research is ongoing, statements and conclusions described in this document are subject to change. The main topics of this report are: (1) fracturing, (2) geohydrology, (3) magmatic activity, and (4) geomorphology. Therefore, the site-specific nature of the problem cannot be overemphasized. As an example of how one might combine the many synergistic and time-dependent parameters into a concise format the reader is referred to A Conceputal Simulation Model for Release Scenario Analysis of a Hypothetical Site in Columbia Plateau Basalts, PNL-2892. For additional details on the topics in this report, the reader is referred to the Pacific Northwest Laboratory (PNL) consultant report listed in the bibliography.

28492 (SAND—79-1109) **Backfill barrier as a component in a multiple barrier nuclear waste isolation system.** Nowak, E.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01.

Quantitative estimates of the potential effectiveness of backfill barriers based on a linear sorption model are presented. Using getters such as clays (known sorbents), a backfill approximately 1-foot-thick can delay by 10^4 to 10^5 years the breakthrough of transuranics. A delay of 10^3 years is possible for major cationic fission products. These delays can be achieved provided that (1) the distribution coefficient (K/sub d/, a measure of affinity for sorbed species) for the barrier material is equal to or greater than 2000 ml/g for transuranics and 200 ml/g for fission products; (2) the interstitial groundwater velocity through the barrier is limited to 1 ft/year or less; (3) the effective porosity of the barrier is equal to or less than 0.1; and (4) the physical integrity of the barrier is maintained (no channels or cracks). Mixtures containing expanding clays such as smectites and other getters are expected to satisfy these criteria.

28493 (SAND—79-1484) **Status of SHAFT 78 with respect to modeling radioactive waste burial in Eleana argillite, including calculations to date.** Eaton, R.R.; Sundberg, W.D.; Larson, D.E.; Sherman, M.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

The SHAFT 78 Code (multidimensional, two fluid phases, porous medium) has been used to begin assessment of the consequences of nuclear waste burial in a 1000-acre repository emplaced in argillite. The methodology used can well be applied to other argillaceous rocks as well as to hard rocks in general so long as their in-situ rock permeability can reasonably be assumed to be temperature- and stress-independent. The repository is assumed to contain spent fuel (SF) UO_2 at an initial power loading of 150 kW/acre and located at a depth of 600 m. It was found that with perfect backfill (permeabilty = 1×10^7 darcy), a maximum fluid pressure of 770 bars existed in the repository at a time of 55 y after burial. Holding all other input variables constant, the maximum fluid pressure in the repository never exceeded the local lithostatic pressure when the permeability of the backfill material was increased to 1×10^{-1} darcy. The calculated temperature histories are essentially independent of backfill permeability and porosity, indicating that heat transfer is conduction-dominated.

28494 **Development and application of criteria for siting.** Waite, D.A.; Newcomb, W.E. (Battelle Project Management Division, Columbus, OH). *Trans. Am. Nucl. Soc.;* **33**: 136-137(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28495 (SAND—80-1319C) **Sandia's activities in uranium mill tailings remedial action.** Neuhauser, S. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 9p. (CONF-800584—1). NTIS, PC A02/MF A01.

From Fish and wildlife service workshop; Ft Collins, CO, USA (28 May 1980).

The Uranium Mill Tailings Radiation Control Act of 1978 requires that remedial action be taken at over 20 inactive uranium

mill tailings sites in the United States. Standards promulgated by the EPA under this act are to be the operative standards for this activity. Proposed standards must still undergo internal review, public comment, and receive Nuclear Regulatory Commission concurrence before being finalized. Briefly reviewed, the standards deal separately with new disposal sites (Part A) and cleanup of soil and contaminated structures at existing locations (Part B). In several cases, the present sites are felt to be too close to human habitations or to be otherwise unacceptably located. These tailings will probably be relocated. New disposal sites for relocated tailings must satisfy certain standards. The salient features of these standards are summarized.

28496 (SAND—80-1464) **Evaluation of tuff as a medium for a nucolear waste repository: interim status report on the properties of tuff.** Johnstone, J.K.; Wolfsberg, K. (eds.). (Sandia National Labs., Albuquerque, NM (USA); Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract AC04-76DP00789. 139p. NTIS, PC A07/MF A01.

This report is the second in a series of summary briefings to the National Academy of Science's (NAS) Committee on Radioactive Waste Management dealing with feasibility of disposal of heat-producing radioactive waste in silicic tuff. The interim status of studies of tuff properties determined on samples obtained from Yucca Mountain and Rainier Mesa (G-tunnel) located on the Nevada Test Site (NTS) are discussed. In particular, progress is described on resolving issues identified during the first briefing to the NAS which include behavior of water in tuff when heated, the effect of the presence or absence of water and joints on the thermal/physical properties of tuff and the detailed/complex sorptive properties of highly altered and unaltered tuff. Initial correlations of thermal/physical and sorptive properties with the highly variable porosity and mineralogy are described. Three in-situ, at-depth field experiments, one nearly completed and two just getting underway are described. In particular, the current status of mineralogy and petrology, geochemistry, thermal and mechanical, radiation effects and water behavior studies are described. The goals and initial results of a Mine Design Working Group are discussed. Regional factors such as seismicity, volcanism and hydrology are not discussed.

28497 (UCRL—15249) **Specifications for the development of a fully three-dimensional numerical groundwater model for regional mass transport of radionuclides from a deep waste repository.** Prickett, T.A. (Camp Dresser and McKee, Inc., Champaign, IL (USA). Water Resources Div.). Apr 1980. Contract W-7405-ENG-48. 326p. NTIS, PC A15/MF A01.

Specifications are given which are necessary to develop a three-dimensional numerical model capable of simulating regional mass transport of radionuclides from a deep waste repository. The model to be developed will include all of the significant mass transport processes including flow, chemical, and thermal advection, mechanical dispersion, molecular diffusion, ion exchange reactions, and radioactive decay. The model specifications also include that density and viscosity fluid properties be functions of pressure, temperature, and concentration and take into account fluid and geologic heterogenieties by allowing possible assignment of individual values to every block of the model. The model specifications furthermore include the repository shape, input/output information, boundary conditions, and the need for documentation and a user's manual. Model code validation can be accomplished with the included known analytical or laboratory solutions. It is recommended that an existing finite-difference model (developed by INTERCOMP and INTERA, Inc.) be used as a starting point either as an acceptable basic code for modification or as a pattern for the development of a completely different numerical scheme. A ten-step plan is given to outline the general procedure for development of the code.

28498 (UCRL—15250) **Conceptual model for regional radionuclide transport from a salt dome repository: a technical memorandum.** Kier, R.S.; Showalter, P.A.; Dettinger, M.D. (Camp Dresser and McKee, Inc., Champaign, IL (USA). Water Resources Div.). 30 May 1980. Contract W-7405-ENG-48. 146p. NTIS, PC A07/MF A01.

Disposal of high-level radioactive wastes is a major environmental problem influencing further development of nuclear energy in this country. Salt domes in the Gulf Coast Basin are being investigated as repository sites. A major concern is geologic and hydrologic stability of candidate domes and potential transport of radionuclides by groundwater to the biosphere prior to their degradation to harmless levels of activity. This report conceptualizes a regional geohydrologic model for transport of radionuclides from a salt dome repository. The model considers transport pathways and the physical and chemical changes that would occur through time prior to the radionuclides reaching the biosphere. Necessary, but unknown inputs to the regional model involve entry and movement of fluids through the repository dome and across the dome-country rock interface and the effect on the dome and surrounding strata of heat generated by the radioactive wastes.

28499 (UCRL—15251) **Dispersive processes in models of regional radionuclide migration. Technical memorandum.** Evenson, D.E.; Dettinger, M.D. (Camp Dresser and McKee, Inc., Walnut Creek, CA (USA)). May 1980. Contract W-7405-ENG-48. 141p. NTIS, PC A07/MF A01.

Three broad areas of concern in the development of aquifer scale transport models will be local scale diffusion and dispersion processes, regional scale dispersion processes, and numerical problems associated with the advection-dispersion equation. Local scale dispersion processes are fairly well understood and accessible to observation. These processes will generally be dominated in large scale systems by regional processes, or macro-dispersion. Macro-dispersion is primarily the result of large scale heterogeneities in aquifer properties. In addition, the effects of many modeling approximations are often included in the process. Because difficulties arise in parameterization of this large scale phenomenon, parameterization should be based on field measurements made at the same scale as the transport process of interest or else partially circumvented through the application of a probabilistic advection model. Other problems associated with numerical transport models include difficulties with conservation of mass, stability, numerical dissipation, overshoot, flexibility, and efficiency. We recommend the random-walk model formulation for Lawrence Livermore Laboratory's purposes as the most flexible, accurate and relatively efficient modeling approach that overcomes these difficulties.

28500 (UCRL—84152) **Effects of annular air gaps surrounding an emplaced nuclear waste canister in deep geologic storage.** Lowry, W.E.; Davis, B.W.; Cheung, H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Northern Arizona Univ., Flagstaff (USA)). 5 Jun 1980. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

Annular air spaces surrounding an emplaced nuclear waste canister in deep geologic storage will have significant effects on the long-term performance of the waste form. Addressed specifically in this analysis is the influence of a gap on the thermal response of the waste package. Three dimensional numerical modeling predicts temperature effects for a series of parameter variations, including the influence of gap size, surface emissivities, initial thermal power generation of the canister, and the presence/absence of a sleeve. Particular emphasis is placed on determining the effects these variables have on the canister surface temperature. We have identified critical gap sizes at which the peak transient temperature occurs when gap widths are varied for a range of power levels. It is also shown that high emissivities for the heat exchanging surfaces are desirable, while that of the canister surface has the greatest influence. Gap effects are more pronounced, and therefore more effort should be devoted to optimal design, in situations where the absolute temperature of the near field medium is high. This occurs for higher power level emplacements and in geomedia with low thermal conductivities. Finally, loosely inserting a sleeve in the borehole effectively creates two gaps and drastically raises the canister peak temperature. It is possible to use these results in the design of an optimum package configuration which will maintain the canister at acceptable temperature levels. A discussion is provided which relates these findings to NRC regulatory considerations.

28501 **Geologic studies for waste repository siting in the Paradox Basin.** Rogers, T.H.; Conwell, F.R. (Woodward-Clyde Consultants, San Francisco, CA). *Trans. Am. Nucl. Soc.;* **33**: 137-138(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28502 **Stochastic aspects of migration from repository sites.** Kiremidjian, A.S.; Kruger, P. (Stanford Univ., CA). *Trans. Am. Nucl. Soc.;* **33**: 138-139(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28503 **Status of siting for the waste isolation pilot plant.** Powers, D.W.; Weart, W.D. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 141-142(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28504 **NNWSI site evaluation activity.** Stephens, H.P. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 142-143(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28505 **Microbial production of tritiated and carbon-14 methane from radioactive wastes.** Francis, A.J.; Dobbs, S.; Doering, R.F.; Colombo, P. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 156-157(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28506 Nonradiological hazards of low-level waste burial grounds. Ausmus, B.S.; Rogers, S.E.; Means, J.L. (Battelle Columbus Labs., OH). *Trans. Am. Nucl. Soc.;* **33**: 157-158(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28507 Chemical toxicity issues in high-level waste disposal. Rogers, S.E.; Ausmus, B.S.; Means, J.L. (Battelle Columbus Labs., OH). *Trans. Am. Nucl. Soc.;* **33**: 158(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28508 Radioactive waste/soil interactions-migration potential of radionuclides through four soils. Fowler, E.B.; Essington, E.H.; Polzer, W.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 164-165(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28509 Migration of transuranic nuclides in earthen burial trenches at the Savannah River Plant. Johnson, D.R.; Wilhite, E.L. (Savannah River Lab., Aiken, SC). *Trans. Am. Nucl. Soc.;* **33**: 167-168(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28510 Transuranic waste degradation under waste isolation pilot plant (WIPP) conditions. Kosiewicz, S.T.; Zerwekh, A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 426(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28511 Wastes mixes and forms for space disposal of nuclear waste. Yates, K.R. (Battelle Columbus Labs., OH). *Trans. Am. Nucl. Soc.;* **33**: 436-437(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28512 Radioactive waste-form and rock interactions: a discussion. Ewing, R.C. (Univ. of New Mexico, Albuquerque); Krumhansl, J.L. *Trans. Am. Nucl. Soc.;* **33**: 280(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 28490, 28491, 28508, 29619

28513 Emission and control of radon at active uranium mines and mills. Roberts, C.J. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 154-155(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28514 Transuranic distribution beneath a retired underground disposal facility at the Hanford Site. Kasper, R.B.; Price, S.M.; Additon, M.K.; Smith, R.M.; Last, G.V.; Wagenaar, G.L. (Rockwell Hanford Operations, Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 165-166(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28515 Plutonium in soil adjacent to Rocky Flats Plant. Hume, M.W.; Illsley, C.T. (Rockwell International, Golden, CO). *Trans. Am. Nucl. Soc.;* **33**: 166-167(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28516 Subsurface migration studies at the Radioactive Waste Management Complex, Idaho. Humphrey, T.G. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 168-169(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28517 Comparative study of the impact of coal and uranium mining, processing, and transportation in the Western US. Sandquist, G.M. (Univ. of Utah, Salt Lake City); Rogers, V.C.; Byrne, J.M. *Trans. Am. Nucl. Soc.;* **33**: 170-171(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28518 Laboratory measurement of diffusion constants for mill tailings covers and its application. Cohen, B.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 173-174(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 28445, 28454, 28487, 28490, 28491, 28495, 28506, 29723

28519 Development and testing of long-term safety assessment methodology for geologic waste repositories. Brandstetter, A. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 140(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28520 Comparison of potential radiological impacts of ^{233}U and ^{239}Pu fuel cycles. Meyer, H.R.; Little, C.A.; Witherspoon, J.P.; Till, J.E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 159-160(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28521 Public radiation exposure considerations during nuclear facility decommissioning. Kennedy, W.E. Jr.; Holter, G.M. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 160-161(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

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From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28523 Iodine-129 dose to the world population from the nuclear power industry. Kocher, D.C.; Till, J.E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 195-197(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28524 Preliminary test program for impact resistance of solid waste forms. Mecham, W.J.; Jardine, L.J.; Steindler, M.J. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 419-421(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28525 Leach studies of plutonium-contaminated incinerator ash incorporated in cement. Nicolosi, S.L.; Neilson, R.M. Jr.; Colombo, P.; Bradley, D.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 421-422(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28526 Determination of nuclear waste-form leach rates by activation analysis. Schumann, R.P. (Exxon Nuclear Idaho, Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 422-423(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28527 Prediction of migration velocities from partition coefficients: cesium in basalt. Williams, J.; Rickert, P.; Seitz, M.G. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 425-426(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28528 Pacific Norwest Laboratory experimental criticality program on LWR fuel element systems. Bierman, S.R. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 358-360(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28529 Utilization of B and W critical facility in support of spent-fuel storage. Hoovler, G.S.; Baldwin, M.N.; Eng, R.L. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.;* **33**: 364-366(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28530 Critical experiments supporting close-packed water storage of power reactor fuel. Hoovler, G.S.; Baldwin, M.N.; Eng, R.L. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.;* **33**: 374-376(1979). (CONF-791103—).

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28531 Criticality of intermediate uranium enrichments. Libby, R.A.; Clayton, E.D. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 377-378(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28532 Nuclear fuel cycle education module on nuclear criticality safety. Knief, R.A. (Univ. of New Mexico, Albuquerque). *Trans. Am. Nucl. Soc.;* **33**: 119-120(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 28434, 28452, 28464, 28942, 28984, 29003

28533 (AGNS—35900-CONF-65) **Automated calibrations and dynamic corrections for differential pressure transmitters.** Crawford, J.M. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jun 1980. Contract AC09-78ET35900. 13p. (CONF-800655—19). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

A large reprocessing plant is a complex operation with dynamic inventories being required to provide for timely detection of attempted diversion of nuclear materials. The real-time, on-line process measurement capability controls the effectiveness of the dynamic techniques. An economical method to eliminate bias and significantly improve process differential pressure transmitter measurements is evaluated. Errors up to 1.0% have been reduced to less than 0.1%

28534 (AGNS—35900-CONF-67) **Advanced access control system.** Barnes, L.D.; King, R.W. (Allied-General Nuclear Services, Barnwell, SC (USA)). Feb 1980. Contract AC09-78ET35900. 11p. (CONF-800655—20). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

A prototype voice verification system has been installed which provides the required positive identification at the main site access control point. This system compares an individual's file voice print with a sample voice print obtained from the individual when an attempt is made to enter the site. The voice system transmits the individual's identity to a central processor. The central processor associates that individual's authorization file with a card-key obtained at the access point. The system generates a record of personnel movement, provides a personnel inventory on a real-time basis, and it can retrieve a record of all prior events. The system installed at the Barnwell Nuclear Fuel Plant is described.

28535 (AGNS—35900-CONF-81) **Advanced integrated safeguards at Barnwell.** Bambas, K.J.; Barnes, L.D. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jun 1980. Contract AC09-78ET35900. 9p. (CONF-800655—26). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

The development and initial performance testing of an advanced integrated safeguards system at the Barnwell Nuclear Fuel Plant (BNFP) is described. The program concentrates on the integration and coordination of physical security and nuclear materials control and accounting at a single location. Hardware and software for this phase have been installed and are currently being evaluated. The AGNS/DOE program is now in its third year of development at the BNFP.

28536 (CONF-780506—(Vol.2), pp 637-640) **Department of Energy (DOE) system for the transportation of strategic quantities of special nuclear material (SQ SNM).** Dickason, D.P. (Dept. of Energy, Albuquerque, NM). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Since 1947 DOE and its predecessor agencies, AEC and ERDA, have moved nuclear materials by a variety of commercial and government transportation modes. In the late 1960's world-wide terrorism and other dissident activities prompted the then-AEC to review its procedures for safeguarding SNM. These reviews resulted in immediate and long-range programs for improvement of overall safeguards. Domestic transportation of completed nuclear weapons and SNM used in the weapons program was selected for special consideration. In the early 1970's AEC started the development of a Safe Secure Trailer (SST) to transport nuclear weapons and nuclear components and the development and installation of a high frequency (HF) communications system to assure continuous radio contact between selected highway and rail shipments and Headquarters, Albuquerque Operations (ALO). Late 1974 AEC directed ALO to develop a transportation system to extend weapons-level protection to all AEC SQ SNM shipments and to consolidate, manage, and operate this system. As of September 1976 all SQ SNM was being transported in the Safe Secure DOE (then ERDA) transportation safeguards system, composed of the following principal elements: (1) Transport equipment consisting of Safe Secure Trailers and specially modified towing tractors; Safe Secure Railcars and specially modified escort coaches; and specially designed highway escort vehicles. (2) An automated high-frequency digital radio system that enables continuous communications between the transporting equipment and central control. (3) A courier force that operates all transport equipment (except aircraft and rail power units) and mobile communications equipment; provides armed protection for shipments; and assures proper safety en route. (4) A central Headquarters staff that plans, executes, and controls shipments and directs, manages, and operates the system.

28537 (CONF-800655—1) **DOE contractor vulnerability analysis: DPA or MAIT.** Six, D.E.; Nichols, D.H. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations; EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

Two vulnerability analysis techniques, Diversion Path Analysis (DPA) and Matrix Analysis of the Insider Threat (MAIT), were applied by EG and G Idaho, Inc. Safeguards and Security to the same item accountable SNM storage area at INEL. Technical and cost data for each methodology were collected and compared. A recommendation that MAIT be utilized for future vulnerability analyses of item accountable SNM storage and use areas operated by EG and G Idaho for DOE-ID resulted. Unclassified results of the two techniques and MAIT/DPA technical and cost comparisons will be presented which show that MAIT can be used for vulnerability analyses to comply with Department of Energy (DOE) requirements.

28538 Fault tree and reliability relationships for analyzing noncoherent two-state systems. Alesso, H.P.; Benson, H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nucl. Eng. Des.;* **56**: No. 2, 309-320(Feb 1980).

Recently, there has been interest in analyzing the noncoherent interactions that result from adversary theft of special nuclear material from reprocessing facilities. The actions of the adversary, acting in conflict with the reprocessing facility's material control and accounting system, may be viewed as a single noncoherent structure. This paper develops a basis for analyzing noncoherent structures by decomposing them into coherent subsystems. Both reliability and fault tree structure functions are used for this analysis. In addition, a bounding criterion is established for the reliability of statistically dependent noncoherent structures.

28539 (K/OA—4660) **Review of NDA technology for enrichment plant safeguards.** Ricci, E.; Fields, L.W.; Rushton, J.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1980. Contract W-7405-ENG-26. 10p. (CONF-800655—22). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

A review of nondestructive assay technology for enrichment plant safeguards is presented with emphasis on field experience. Actual and potential applications of this technology in domestic and international safeguards are described. Domestic applications of NDA emphasize verification of uranium enrichment in UF_6 storage cylinders and measurement of uranium in scrap and waste materials. International applications also would involve measurements to detect covert production of uranium enrichments above declared values. The state of development and application of standard techniques, e.g. gamma-ray and passive neutron assay of ^{235}U in UF_6 cylinders, are reviewed critically based on experience at the US gaseous diffusion plants. Random driver measurements and segmented gamma scanning of wastes and trap materials are described. New instruments such as portable intrinsic Ge detectors and enrichment monitors for gaseous UF_6 are identified.

28540 (LA—8358-MS) **Coprecal: materials accounting in the modified process.** Dayem, H.A.; Kern, E.A.; Shipley, J.P. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01.

This report presents the design and evaluation of an advanced materials accounting system for a uranium-plutonium nitrate-to-oxide coconversion facility based on the General Electric Coprecal process as modified by Savannah River Laboratory and Plant and DuPont Engineering. The modifications include adding small aliquot tanks to feed the process and reconfiguring the calciner filter systems. Diversion detection sensitivities for the modified Coprecal

process are somewhat better than the original Coprecal design, but they are still significantly worse than a same-sized conversion facility based on the oxalate (III) precipitation process.

28541 (SAND—80-0529C) **Combined SAFE/SNAP approach to safeguards evaluation.** Engi, D.; Chapman, L.D.; Grant, F.H.; Polito, J. (Sandia National Labs., Albuquerque, NM (USA); Pritsker and Associates, Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-800655—2). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

Generally, the scope of a safeguards evaluation model can efficiently address one of two issues, (1) global safeguards effectiveness, or (2) vulnerability analysis for individual scenarios. The Safeguards Automated Facility Evaluation (SAFE) focuses on (1) while the Safeguards Network Analysis Procedure (SNAP) is directed at (2). SAFE addresses (1) in that it considers the entire facility, i.e., the composite system of hardware and human components, in one global analysis. SNAP addresses (2) by providing a safeguards modeling symbology sufficiently flexible to represent quite complex scenarios from the standpoint of hardware interfaces while also accounting for a rich variety of human decision making. A combined SAFE/SNAP approach to the problem of safeguards evaluation is described and illustrated through an example.

28542 (UCRL—82248) **Evaluating physical protection systems of licensed nuclear facilities using systems engineered inspection guidance.** Bradley, R.T.; Olson, A.W.; Rogue, F.; Scala, S.; Richard, E.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Nuclear Regulatory Commission, Washington, DC (USA)). 23 Jun 1980. Contract W-7405-ENG-48. 10p. (CONF-800655—21). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

The Lawrence Livermore National Laboratory (LLNL) and the US Nuclear Regulatory Commission (NRC) Office of Nuclear Regulatory Research (RES) have applied a systems engineering approach to provide the NRC Office of Inspection and Enforcement (IE) with improved methods and guidance for evaluating the physical protection systems of licensed nuclear facilities.

28543 **Aggregated systems model: a tool for nuclear safeguards decision making.** Al-Ayat, R.; Judd, B. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **33**: 438-439(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28544 **Evaluation of a nondestructive assay technique for on-line assay of fuel rods in an HTGR fuel refabrication plant.** Allen E.J.; Rushton, J.E.; Chiles, M.M.; Jenkins, J.D. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 441-442(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28545 **Removing multiplication effects from neutron coincidence counting using Monte Carlo.** Stewart, J.E.; Ensslin, N.; Schrandt, R.G. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 442-444(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28546 **Thermal-neutron coincidence counting system.** Erkkila, B.H.; Marshall, R.S. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 444-445(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28547 **Economics benefits of an international fuel exchange agreement.** Ligon, D.M.; Brogli, R.H. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 447-448(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28548 **Development of educational modules for safeguards and nuclear waste management.** O'Hara, F.A.; Wurm, K.J. (Battelle Columbus Lab., OH). *Trans. Am. Nucl. Soc.;* **33**: 122-123(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 28456, 28457

FUSION FUELS

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

28549 **Improved method for producing small hollow spheres.** Rosencwaig, A.; Koo, J.C.; Dressler, J.L. US Patent Application 061,167. [nd]. 28p.

An improved method and apparatus for producing small hollow spheres of glass having an outer diameter ranging from about 100μ to about 500μ with a substantially uniform wall thickness in the range of about 0.5 to 20μ are described. The method involves introducing aqueous droplets of a glass-forming solution into a long vertical drop oven or furnace having varying temperature regions.

28550 (UCID—18719) **Preliminary analysis of a target factory for laser fusion.** Sherohman, J.W.; Hendricks, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1980. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01.

An analysis of a target factory leading to the determination of production expressions has provided for the basis of a parametric study. Parameters involving the input and output rate of a process system, processing yield factors, and multiple processing steps and production lines have been used to develop an understanding of their dependence on the rate of target injection for laser fusion. Preliminary results have indicated that a parametric study of this type will be important in the selection of processing methods to be used in the final production scheme of a target factory.

28551 (UCRL—83532) **RF magnetron sputtering of thick platinum coatings on glass microspheres.** Meyer, S.F.; Hsieh, E.J.; Burt, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 May 1980. Contract W-7405-ENG-48. 14p. (CONF-800439—9). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

Thick platinum coatings on glass microspheres are needed for proposed Laser Fusion targets. The spherical nature of these substrates coupled with the small dimensions (~ 100 μm OD) make it difficult to achieve a smooth and uniform coating. Coating problems encountered include a rough surface and porous microstructure from the oblique incidence and lack of temperature and bias control, clumping of the microspheres causing non-uniformities, and particle accumulation causing cone defects. Sputtering parameters significantly affecting the coatings include total pressure, DC substrate bias, and the addition of doping gases. Using an ultrasonic vibrating screened cage and RF magnetron Sputtergun, we have successfully batch coated microspheres with up to 6 μm of Pt, with a surface roughness of 200 nm, thickness non-concentricity of 300 nm, and density greater than 98% of bulk Pt.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 28562

28552 (BNL—27782) **Fusion reactors for hydrogen production via electrolysis.** Fillo, J.A.; Powell, J.R.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 7p. (CONF-791204—37). NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The decreasing availability of fossil fuels emphasizes the need to develop systems which will produce synthetic fuel to substitute for and supplement the natural supply. An important first step in the synthesis of liquid and gaseous fuels is the production of hydrogen. Thermonuclear fusion offers an inexhaustible source of energy for the production of hydrogen from water. Depending on design, electric generation efficiencies of ~ 40 to 60% and hydrogen production efficiencies by high temperature electrolysis of ~ 50 to 70% are projected for fusion reactors using high temperature blankets.

28553 (BNL—27891) **Fusion: an energy source for synthetic fuels.** Fillo, J.A.; Powell, J; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-800590—1). NTIS, PC A02/MF A01.

From AIAA international meeting and technical display global technology 2000; Baltimore, MD, USA (6 May 1980).

The decreasing availability of fossil fuels emphasizes the need to develop systems which will produce synthetic fuel to substitute for and supplement the natural supply. An important first step in the

synthesis of liquid and gaseous fuels is the production of hydrogen. Thermonuclear fusion offers an inexhaustible source of energy for the production of hydrogen from water. Depending on design, electric generation efficiencies of ~ 40 to 60% and hydrogen production efficiencies by high temperature electrolysis of ~ 50 to 70% are projected for fusion reactors using high temperature blankets. Fusion/coal symbiotic systems appear economically promising for the first generation of commercial fusion synfuels plants. Coal production requirements and the environmental effects of large-scale coal usage would be greatly reduced by a fusion/coal system. In the long term, there could be a gradual transition to an inexhaustible energy system based solely on fusion.

WASTE MANAGEMENT

28554 Evaluation of the requirements and performance of a transmutation waste management system. Davidson, J.W. (Univ. of Texas, Austin); Parish, T.A. *Trans. Am. Nucl. Soc.;* 33: 79-81(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

HEAVY WATER PRODUCTION

28555 Chromatographic hydrogen isotope separation. Aldridge, F.T. US Patent Application 041,364. [nd]. 10p.

Intermetallic compounds with the $CaCu_5$ type of crystal structure, particularly $LaNiCo_4$ and $CaNi_5$, exhibit high separation factors and fast equilibrium times and therefore are useful for packing a chromatographic hydrogen isotope separation column. The addition of an inert metal to dilute the hydride improves performance of the column. A large scale multi-stage chromatographic separation process run as a secondary process off a hydrogen feedstream from an industrial plant which uses large volumes of hydrogen cn produce large quantities of heavy water at an effective cost for use in heavy water reactors.

RADIATION SOURCES

28556 (SAND—80-0121) **Beneficial uses program. Progress report, period ending September 30, 1979.** (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract AC04-76DP00789. 71p. NTIS, PC A04/MF A01.

Progress in the Beneficial Uses Program during the quarter ending September 30, 1979 is described. Operational Safety Requirements and Standard Operating Procedures for the Sandia Irradiator for Dried Sewage solids were written and approved. The contractor for the Technology Transfer Program was selected. A study was completed to determine the mechanisms of poliovirus inactivation by direct and indirect effects of ionizing radiation. Direct effects were found to be due primarily to RNA damage while indirect effects appeared to be mostly due to protein damage. A large scale bacterial inactivation study was begun. Effects of moisture loss by evaporation, regrowth inhibition by moisture reduction and competitive inhibitors for specific general will be studied. preliminary scoping results on radiation inactivation were obtained. Animal refeeding studies at New Mexico State University were expanded to include extensive forage digestability studies with steers supplemented with Las Cruces sludges. A large breeding experiment with sheep was also started to determine supplementation effects on reproduction efficiency, weight changes, lambing data and hormonal responses. Greenhouse experiments on the effects of sludge additions on heavy metal behavior are progressing. The separation technology and source development program for cesium 137 at Sandia was transferred to ORNL on September 30, 1979. Pollucite pellets containing 37.5% cesium have been successfully fabricated. It appears that these pellets will be satisfactory for use in irradiators such as SIDSS.

ISOTOPIC POWER SUPPLIES

28557 (DOE/ET/33021—T1) **Design evolution and verification of the general-purpose heat source.** Schock, A. (Fairchild Space and Electronics Co., Germantown, MD (USA)). [nd]. Contract AC02-77ET33021. 11p. NTIS, PC A02/MF A01.

The General-Purpose Heat Source (GPHS) is a radioisotope heat source for use in space power systems. It employs a modular design, to make it adaptable to a wide range of energy conversion systems and power levels. Each 250 W module is completely autonomous, with its own passive safety provisions to prevent fuel release under all abort modes, including atmospheric reentry and earth impact. Prior development tests had demonstrated good impact survival as long as the iridium fuel capsules retained their ductility. This requires high impact temperatures, typically above 900°C and reasonably fine grain size, which in turn requires avoidance of excessive operating temperatures and reentry temperatures. These three requirements - on operating, reentry, and impact temperatures - are in mutual conflict, since thermal design changes to improve any one of these temperatures tend to worsen one or both of the others. This conflict creates a difficult design problem, which for a time threatened the success of the program. The present paper describes how this problem was overcome by successive design revisions, supplemented by thermal analyses and confirmatory vibration and impact tests; and how this may be achieved while raising the specific power of the GPHS to 83 W/lb, a 50% improvement over previously flown radioisotope heat sources.

HYDROGEN

PRODUCTION

ELECTROLYSIS

REFER ALSO TO CITATION(S) 28552

28558 Hydrogen production by the decomposition of water. Hollabaugh, C.M.; Bowman, M.G. US Patent Application 062,373. [nd]. 24p.

A process is described for the production of hydrogen from water by a sulfuric acid process employing electrolysis and thermochemical decomposition. The water containing SO_2 is electrolyzed to produce H_2 at the cathode and to oxidize the SO_2 to form H_2SO_4 at the anode. After the H_2 has been separated, a compound of the type M/sub r/X/sub s/ is added to produce a water insoluble sulfate of M and a water insoluble oxide of the metal in the radical X. In the compound M/sub r/X/sub s/, M is at least one metal selected from the group consisting of Ba^{2+}, Ca^{2+}, Sr^{2+}, La^{2+}, and Pb^{2+}; X is at least one radical selected from the group consisting of molybdate (MoO_4^{2-}), tungstate (WO_4^{2-}), and metaborate (BO_2^{1-}); and r and s are either 1, 2, or 3 depending upon the valence of M and X. The precipitated mixture is filtered and heated to a temperature sufficiently high to form SO_3 gas and to reform M/sub r/X/sub s/. The SO_3 is dissolved in a small amount of H_2O to produce concentrated H_2SO_4, and the M/sub r/X/sub s/ is recycled to the process. Alternatively, the SO_3 gas can be recycled to the beginning of the process to provide a continuous process for the production of H_2 in which only water need be added in a substantial amount. (BLM)

28559 (BNL—51060) **Electrolysis-based hydrogen storage systems. Annual report, January 1, 1978-December 31, 1978.** (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract AC02-76CH00016. 86p. NTIS, PC A05/MF A01.

Contract management, technical monitoring and in-house research conducted by Brookhaven National Laboratory for the US Department of Energy, Division of Energy Storage as described. The status of each project within four major areas of investigation is summarize. Activities deal with: (1) Electrolytic Production of Hydrogen; (2) Hydrogen Storage Systems; (3) Hydrogen Storage Materials; and (4) Systems Studies/End-Use Applications. The BNL programmatic responsibilities encompass the direction of 17 contractors and a $3,200,000 budget.

28560 Electrolysis-based hydrogen storage technology. Strickland, G. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* 33: 11-12(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 28558

28561 (LA-UR—80-1612) **Studies on the LASL cadmium-cadmium carbonate cycle.** Mason, C.F.V.; Bowman, M.G.; Behrens, R.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800660—1). NTIS, PC A02/MF A01.

From Thermochemical hydrogen workshop; Tsukuba, Japan (18 Jun 1980).

The following results were obtained from studies on the cadmium-cadmium carbonate cycle. A new lower limit for the heat of formation of CdO(g) has been estimated ΔH°/sub f,298/ > 113.8 kJ/mol. Hydrogen production is subject to catalysis. While Pd is an effective catalyst, NH_4Cl shows greater catalytic activity. Seventy-two percent of the total available H_2 is formed in one-half hour at 523°K using NH_4Cl as a catalyst. Four to five moles of water must be removed from $CdCO_3$ prior to its thermal decomposition.

28562 Hydrogen production using fusion energy and thermochemical cycles. Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, NY). *Int. J. Hydrogen Energy;* 5: No. 2, 119-129(1980).

Thermochemical cycles for the production of synthetic fuels would be especially suited for operation in conjunction with controlled thermonuclear fusion reactors because of very high temperature energy which such reactors could supply. Furthermore, fusion energy when developed is considered to be an inexhaustible supply of energy. Several high-temperature, two-step thermochemical cycles for the production of hydrogen are examined. A thermodynamic analysis of the Fe_3O_4-FeO, $CrCl_3$-$CrCl_2$, and UCl_4-UCl_3 pairs reveals the feasibility of the processes. A more detailed process analysis is given for the Fe_3O_4-FeO system using steam as the heat transfer medium for decomposing the higher valent metal oxide for oxygen production, and hydrolyzing the lower oxide for hydrogen production. The steam could be heated to high temperatures by refractory materials absorbing the 14MeV neutrons in the blanket region of a fusion reactor. Process heat transfer and recovery could be accomplished by regenerative reactors. Proposed operating conditions, the energy balance, and the energy efficiency of water decomposition process are presented. With a fusion blanket temperature of 2500 K, thermal efficiencies for hydrogen production (HHV) of 74.4% may be obtained.

28563 Cadmium-cadmium hydroxide thermochemical water-splitting cycle. Schreiber, J.; Foh, S.; Remick, R. Chicago, IL; Institute of Gas Technology (1980). 13p. (CONF-800616—7).

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

The Institute of Gas Technology (IGT) has derived and developed a hybrid thermochemical water-splitting cycle based on cadmium chemistry: (1) $Cd(s) + 2H_2O(l) \rightarrow Cd(OH)_2(s) + H_2(g)$, (2) $Cd(OH)_2(s) \rightarrow CdO(s) + H_2O(g)$, and (3) $CdO(s) \rightarrow Cd(g) + 1/2\ O_2(g)$. All steps in this cycle have been tested in the laboratory and proven workable. Reaction 1 is an electrochemical step that can operate at below 0.4 V. Novel electrochemical solutions to the problem of anodic passivation are presented. The high-temperature (T > 1300°K) decomposition of cadmium oxide (Reaction 3) is scheduled for testing at the US Army White Sands Solar Facility in New Mexico in 1980. A rapid quench may be required to prevent recombination of the Cd and O_2 produced. A conceptual engineering analysis shows that if some heat can be recovered from the decomposition products, this cycle will have a very high energy efficiency - in excess of 50%.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 29404, 29626

28564 (ORNL/TM—6328/V1, pp 151-186) **Bioengineering research.** Shumate, S.E. II. Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

Efforts in the bioengineering research program were concerned with the utilization of microorganisms or materials derived from microorganisms (e.g., enzymes, organelles) to carry out useful process functions for energy production and conservation, resource recovery, and environmental protection. Studies related to enzyme catalysis were focused on the enzyme-catalyzed reduction of water to produce hydrogen. Techniques were developed for enzyme separation, purification, stabilization, and immobilization. Factors affecting the rate of reduction of the electron carrier, ferredoxin, by sodium dithionite were studied. Investigations specific to problems in nuclear waste management which included the removal of radionuclides and chemical contaminants from aqueous process and effluent streams were made. Bioreactor component studies which addressed the construction and operation of a large fluidized-bed reactor with tapered entrance and fluid-particle disengaging sections were carried out, and a description of fluid and particle behavior in a two-phase (liquid-solid) fluidized bed was obtained from an analysis of data taken during the operation.

COAL GASIFICATION

28565 (FE—2855-6) **Catalytic conversion of coal energy to hydrogen. Project quarterly report, August 1-October 31, 1978.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA). Chemistry and Chemical Engineering Lab.). Nov 1978. Contract ET-78-C-01-2855. 79p. NTIS, PC A05/MF A01.

Restoration of the elevated pressure, fluidized reactor system was completed and gasification tests initiated for studying the effects which variable catalyst and carbon dioxide acceptor levels have on char conversion kinetics, product distributions, and acceptor utilization at elevated reaction pressures. In these experimental tests chemically pure lime and dolomite were shown not to be effective catalysts for the 700°C, 0.28 MPa pressure, fluidized char-steam reaction. When combined, however, with potassium carbonate catalyst, both lime and dolomite were demonstrated to significantly promote the activity of the alkali catalyst activity over that of the pure catalyst. The char-steam and char-acceptor-steam reactions, catalyzed with potassium carbonate, were both observed to be pseudo first order dependent on carbon under the excess steam conditions employed, and the rate constants for the reactions were linearly dependent on catalyst concentrations of the test mixtures charged to the reactor. Five additional process parameters were examined in the continuing effort to identify areas where significant product cost reduction may be achievable in the baseline catalytic process design. Parameters considered included: reduction of char ash content, substitution of limestone for dolomite as the acceptor, reduction of char sulfur content, catalyst deactivation rate, and utilization of the magnesium oxide content of dolomite as a partial sulfur acceptor. In all cases, hydrogen product costs were observed to increase slightly over the baseline design. The percentage increases were small and were, for the most part, the result of having to purchase additional electric power to maintain process energy balances. The effect of these parameters on product costs may be reversed if additional electric power could be generated in the process through a small increase in char consumption.

STORAGE

REFER ALSO TO CITATION(S) 28560

CHEMISORPTION

REFER ALSO TO CITATION(S) 28559

UNDERGROUND

REFER ALSO TO CITATION(S) 28559

28566 Underground storage of hydrogen. Foh, S.E.; Rockar, E.M. Chicago, IL; Institute of Gas Technology (1980). 21p. (CONF-800580—1).

From American Gas Association transmission conference; Salt Lake City, UT, USA (5 May 1980).

An extensive study of the technical and economic feasibility of storing hydrogen gas in underground reservoirs is briefly summarized. A depleted gas field, an aquifer, a salt cavern, and an excavated rock cavern were studied. Although the designs of hydrogen storage facilities will differ somewhat from typical natural gas storage facilities, the only major technical unknown is the potential effects of hydrogen embrittlement, which will probably require materials development and testing for pressures above 1200 psi. An economic methodology, based on utility financing, was developed to predict the cost of service for underground hydrogen storage. After testing this methodology against known costs of service for natural gas storage to verify its accuracy, we used the methodology to determine which costs most influenced the overall cost of service for hydrogen.

TRANSPORT

28567 Use of natural gas distribution systems to deliver hydrogen. Gregory, D.P. Chicago, IL; Institute of Gas Technology (1980). 5p. (CONF-800382—1).

From 1980 Canadian energy exposition; Toronto, Canada (15 Mar 1980).

A complex system of gas distribution equipment, consisting of many kinds of pipes, fittings, meters, regulators, valves, and other equipment typical of present-day gas distribution systems, was constructed in the laboratory at the Institute of Gas Technology. The equipment was hooked up in a loop system. The system was operated on natural gas for a few weeks before being switched to pure hydrogen for a 6-month test. The results of the test are summarized.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 28559

OTHER SYNTHETIC AND NATURAL FUELS

OTHER SYNTHETIC AND NATURAL FUELS

HYDROCARBON FUELS

PROPERTIES

28568 Effect of substituents on the electron densities in methane. σ and π interactions in saturated systems. Wiberg, K.B. (Yale Univ., New Haven, CT). *J. Am. Chem. Soc.;* **102**: No. 4, 1229-1237(13 Feb 1980).

Wave functions for a series of methyl derivatives have been converted into electron-density distributions. The space about the carbon has been separated into regions which may be attributed to each of the atoms, and the electron populations have been obtained for each region by numerical integration of the electron densities. Although it is not readily possible to assign a unique electron population to the methyl hydrogens, because of the dependence on the size chosen for the volume element about carbon, the charge shifts at hydrogen have been found to be relatively unaffected by the carbon size. The charge shifts have been determined and have been separated into σ and π components. Substitutents may be σ acceptors or donors, and π acceptors or donors, and affect methane in much the same fashion as has been found for benzene derivatives.

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 29391, 29399

28569 Clusters and catalysis: on the requirement for multinuclear centers to catalyze the hydrogenation of carbon monoxide. Brenner, A.; Hucul, D.A. (Wayne State Univ., Detroit, MI). *J. Am. Chem. Soc.;* **102**: No. 7, 2484-2487(26 Mar 1980).

Efficient homogeneous catalysis by mononuclear complexes of certain reactions, such as methanation and Fischer-Tropsch synthesis has not been achieved. It has recently been demonstrated that temperature programmed decomposition (TPDE) of carbonyls adsorbed on silica or alumina leads to the formation of novel subcarbonyl species which are highly dispersed and which can be stable to 7250°C, a temperature sufficient for catalysis of methanation over supported metals. A detailed study was undertaken of the dependence of CH_4 formation (during TPDE) on the nuclearity of the alumina supported complexes. The results suggest a novel reaction sequence for catalytic methanation: $M + CO \rightarrow M(CO)ads$ (8); $4\sigma\text{-}OH + M(CO)ads \rightarrow MO_3 + 2\sigma\text{-}O^- + CH_4$ (9); $3H_2 + MO_3 \rightarrow M + 3H_2O$ (10); $2H_2O + 2\sigma\text{-}O^- \rightarrow 4\sigma\text{-}OH$ (11); $CO + 3H_2 \rightarrow CH_4 + H_2O$ (12). Reactions 8, 10, and 11 are well known. Reaction 9 simply expresses the known stoichiometry of CH_4 formation during the TPDE of carbonyls in flowing He. Reaction 9 presumedly represents a sequence of steps which would cycle with reactions equivalent to 10 and 11 so that M only gets slightly oxidized during reaction. A unique feature of this scheme is that CH_4 is formed by reaction with σ-OH, the role of the H_2 being to rereduce the metal. High reactivity for catalytic methanation of $Mo(CO)_6$ $W(CO)_6$ supported anAl_2O_3 has also been discovered, the activities being roughly 100-fold higher than for analogous traditional heterogeneous catalysts. 4 figures, 2 tables. (DP)

28570 Process for the production of hydrocarbons and oxygen-containing compounds and catalysts therefor. Koelbel, H.; Tillmetz, K.D. (to Schering Aktiengesellschaft). US Patent 4,177,203. 4 Dec 1979. Filed date 6 Oct 1977. 10p.

Processes for synthesizing unsaturated and saturated hydrocarbons and oxygen-containing compounds by catalytic hydrogenation of carbon monoxide at temperatures of 220 to 375 degrees C and pressures from 1 to 60 bars. Specially activated catalysts for this purpose contain at least 50% manganese and less than 50% iron, by weight. The product distribution spectrum is shifted in the direction of C_2 to C_4 hydrocarbons, the chain length of the products extending only to about C_6 and methane being formed only in traces.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 28619, 28620, 28622, 28625, 28630, 28631, 28633, 28634

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 28582, 29194

28571 (GFETC/IC—79/1, pp 147-156) Methanol derivation from North Dakota lignite and use as a fuel. Glass, E.C. (Northern States Power Co., Minneapolis, MN); Freeman, A.L.; Wentworth, T.O. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The potential use of methanol as utility and industrial boiler fuel and by gas utilities is described. Results of a feasibility study for production of up to 25,000 tpd of methanol from North Dakota lignite are presented. Total capital requirements would be about $2.5 billion (1978 dollars), and depending upon financing and final design selection f.o.b. costs for methanol would range from $3 to $4.80 per 10^6 Btu. Some 840 employees would be required, 2.5 x 10^6 tpy of lignite consumed, and 5.5 years lead-time necessary for construction. The process would consist of gasification, shift conversion and methanol synthesis. Environmental impact and water requirements would be low. Review of the project proposal concluded that developmental work was still required in preparation of the lignite-water slurry for gasifier feed and in scale-up of the gasifier for use at 1550 psig.

PROPERTIES

28572 Structure and properties of liquid methanol. Jorgensen, W.L. (Purdue Univ., West Lafayette, IN). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 2, 543-549(16 Jan 1980).

Statistical mechanics simulations of liquid methanol at 25°C have been carried out using an intermolecular potential function derived from ab initio molecular orbital calculations with added dispersion corrections. Detailed structural and thermodynamic information has been obtained and compares favorably with the available experimental results including x-ray and infrared data. The liquid primarily consists of long, winding hydrogen bonded chains. Roughly linear hydrogen bonding dominates. Most monomers (56%) are in two hydrogen bonds; 24 and 17% are in one and three hydrogen bonds, respectively, and there is 2.5% monomer present in the liquid. Stereoplots give little indication of dimers, though various higher oligomers are evident. The singly hydrogen bonded monomers occur at the ends of chains, while the monomers with three hydrogen bonds are at Y junctions. For the first time in a liquid simulation, the binding energy distribution is found to be bimodal rather than unimodal. The higher energy peak is proved to be due to the singly hydrogen bonded monomers. Overall, the results confirm the capabilities of computer-simulation techniques to successfully model complex fluids.

PREPARATION

CHEMICAL SYNTHESIS

28573 (FE—3177-5) Methanol and methyl fuel catalysts. Calendar year report, September 1978-November 1979. Klier, K.; Herman, R.G. (Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research). Dec 1979. Contract AS01-78ET10741. 9p. NTIS, PC A02/MF A01.

Results of diffuse reflectance studies and quantitative x-ray powder diffraction measurements support the proposal that Cu^+/ZnO solid solution is the catalytically important moiety in low pressure methanol synthesis catalysts. Decreasing the CO_2 concentration in the syngas from 6% to $\leq$ 2% resulted in a slight improvement in methanol yield with th Ce-based Cu/ZnO catalysts. However, a similar decrease in CO_2 concentration led to a decrease in carbon conversion to methanol over Al-based Cu/ZnO catalysts. This difference in kinetic behavior shows a remarkable influence of the support on the course of the synthesis. The dependence of reaction rates on CO_2 concentration is actively investigated for these catalysts and for La-based ternary catalysts, as well as for binary and ternary catalysts doped with alkali metal ions such as Rb^+. Although the effects of CeO_2, Al_2O_3 and La_2O_3 on the methanol synthesis kinetics in the presence of CO_2 are very marked, these oxides do not appear to change the composition of the product and all catalysts investigated here are still highly selective to methanol.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 28625, 28627, 28630, 28632, 28634

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 28626, 28628, 28629, 28637, 29210

28574 (DPE—3537) **Savannah River Plant: the feasibility of converting plant and municipal refuse to energy.** Murray, C.D. (Du Pont de Nemours (E.I.) and Co., Wilmington, DE (USA). Engineering Dept.). Jun 1978. Contract AC09-76SR00001. 70p. NTIS, PC A04/MF A01.

Preliminary investigations into the feasibility of using solid wastes as fuel at the Savannah River Plant (SRP) were conducted. Methods for the conversion of solid wastes were investigated. Burning, pyrolysis, gas recovery from landfills, shredding, sorting, materials recovery, and pelletizing were proposed. The pelletizing process was considered the optimum method for converting refuse to energy at SRP. The advantages of pelletized refuse derived fuel were discussed. A 200 ton per day pelletizing pilot plant, a system for transport of the fuel, and a fuel handling system will be constructed. (DC)

HYDRO ENERGY

REFER ALSO TO CITATION(S) 28677

RESOURCES AND AVAILABILITY

28575 **Small hydro-electric potential of Nelson.** Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 49p. (NZERDC—47).

In this study of the hydroelectric potential of the Tasman Electric Power Board's area, nineteen schemes have been identified, including two options for each of three possible developments. Allowing for these alternatives sixteen schemes could be developed and of this total seven would appear to be economic under present criteria for the development of Local Authority Schemes. A further three schemes, although presently uneconomic, are considered worthy of further investigation. These ten schemes are listed and represent the foreseeable development of hydro potential in the study area. These schemes could generate about 500 GWh p.a. which is approximately 50% more than the TEPB's existing requirements. With the exception of the diversion of water into the Cobb Reservoir and the two schemes on the Aorere River which may be more suited to State Development, these schemes would be suitable for development by the TEPB.

PLANT DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 29575

ENVIRONMENTAL ASPECTS

LAND USE AND AESTHETICS

28576 **Black River hydro project: local gain st whose cost.** Hunter, W. *Sol. Law Rep.;* 1: No. 6, 1118-1127(Mar 1980).

It is argued that regulatory procedures for projects such as the Black River Hydroelectric Project should include a comprehensive regional political - economic analysis to safeguard the interests of those whose lands are to be appropriated. (SPH)

SOLAR ENERGY

REFER ALSO TO CITATION(S) 29166

28577 (SERI/TP—334-489) **Reliability engineering in solar energy: workshop proceedings.** Gross, G. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1980. Contract AC02-77CH00178. 46p. NTIS, PC A03/MF A01.

A workshop to reveal the scope of reliability-related activities in solar energy conversion projects and in nonsolar segments of industry is described. Two reliability programs, one in heating and cooling and one in photovoltaics, are explicated. This document also presents general suggestions for the establishment of a unified program for reliability, durability, maintainability, and safety (RDM and S) in present and future solar projects.

28578 (SERI/TP—733-693) **Applications of solar energy in industrial parks.** Greaver, V.W.; Farrington, R.B.; Leboeuf, C.M. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract EG-77-C-01-4042. 8p. (CONF-800706—2). NTIS, PC A02/MF A01.

From Western plant engineering conference; Anaheim, CA, USA (15 Jul 1980).

The four phases of ongoing work at SERI that examines many unresolved questions regarding the purpose, solar applicability, economics, and energy modeling of industrial parks are presented. The first phase involved site visits to approximately 300 parks in 12 major metropolitan areas of 9 states. Phase 2 entails an analysis of four parks selected from those parks surveyed. Phase 3 narrows the focus to two parks to be examined for detailed technical and engineering analysis. Phase 4 incorporates all of the work of the earlier phases with economic criteria to produce an energy allocation model describing energy delivery and consumption within the park.

28579 **Major Solar Energy Research Programs.** Touryan, K.J. (Solar Energy Research Inst., Golden, CO). *Trans. Am. Nucl. Soc.;* 33: 22-24(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 28656

28580 (DOE/ET/20090—3) **Solar index generation and delivery.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). 1980. Contract AC02-78ET20090. 96p. NTIS, PC A05/MF A01.

The Solar Index, or, more completely defined as the Service Hot Water Solar Index, was conceptualized during the spring of 1978. The purpose was to enhance public awareness to solar energy usability. Basically, the Solar Index represents the percentage of energy that solar would provide in order to heat an 80 gallon service hot water load for a given location and day. The Index is computed by utilizing SOLCOST, a computer program, which also has applications to space heating, cooling, and heat pump systems and which supplies economic analyses for such solar energy systems. The Index is generated for approximately 68 geographic locations in the country on a daily basis. The definition of the Index, how the project came to be, what it is at the present time and a plan for the future are described. Also presented are the models used for the generation of the Index, a discussion of the primary tool of implementation (the SOLCOST program) and future efforts.

28581 (SOLAR/0010—80/05) **Environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). May 1980. Contract AC01-79CS30027. 220p. NTIS, PC A10/MF A01.

The National Solar Data Program established solar energy systems in residential and commercial buildings across the United States. These solar sites are linked to a computer in the National Solar Data Network (NSDN). Data from this network is collected and analyzed to determine the thermal performance of each of the solar systems. The network consists of: (1) sensors which measure key performance parameters at a selected site; (2) a Site Data Acquisition Subsystem (SDAS); (3) telephone transmission circuits; and (4) a Central Data Processing System (CDPS). Sensor data are collected and stored on a cassette tape in the SDAS. For the majority of parameters, raw data is collected approximately every five minutes. Solar insolation and certain other parameters, which are subject to rapid variance, are sampled every 32 seconds. Environmental information collected at the sites for the reporting month are presented. The data include: insolation, temperature, wind, and humidity. (MHR)

ECONOMICS

REFER ALSO TO CITATION(S) 28647, 28743, 29209

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 28635, 28638, 28743, 28754, 29188, 29209

28582 **Legislation: federal legislation-abstracts; state legislation-abstracts.** *Sol. Law Rep.;* 1: No. 3, 613-694(Sep 1979).

Abstracts are presented of federal and state legislation pertaining to solar energy and conservation. The bill number, sponsor, dates, committees, and history are given for each house and senate bill. A subject index is given following the abstracts. (LS)

28583 (LA-UR—80-1562) **SPS environmental effects on the upper atmosphere.** Duncan, L.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-800672—1). NTIS, PC A02/MF A01.

From International symposium on solar power satellites; Toulouse, France (25 Jun 1980).

The ionospheric effects and associated environmental impacts which may be produced during the construction and operation of a solar power satellite system are reviewed. Propellant emissions from heavy lift-launch vehicles are predicted to cause widespread ionospheric depletions in electron and ion densities. Collisional damping of the microwave power beam in the lower ionosphere can significantly enhance the local free electron temperatures. Thermal self-focusing of the power beam in the ionosphere may excite variations in the beam power-flux density and create large-scale field-aligned electron density irregularities. These large-scale irregularities may also trigger the formation of small-scale plasma striations. Ionospheric modifications can lead to the development of potentially serious telecommunications and climate impacts. A comprehensive research program is being conducted to understand the physical interactions driving these ionospheric effects and to determine the scope and magnitude of the associated environmental impacts.

28584 (ORAU/IEA—80-2(M)) **Social control of energy: a case for the promise of decentralized solar technologies.** Gilmer, R.W. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). May 1980. Contract AC05-76OR00033. 42p. NTIS, PC A03/MF A01.

The case for simplified social control is developed in two ways. First, decentralized solar technology and centralized electric utilities are contrasted in the ways they assign property rights in capital and energy output; in the assignment of operational control; and in the means of monitoring, policing, and enforcing property rights. Second, an analogy is drawn between the decision of an energy consumer to use decentralized solar and the decision of a firm to vertically integrate, that is, to extend the boundary of the firm by making inputs or further processing output. Decentralized solar energy production offers the small energy consumer the chance to cut ties to outside suppliers - to vertically integrate energy production into the home or business. The development of this analogy provides insight into important noneconomic aspects of solar energy, and it points clearly to the lighter burdens of social management offered by decentralized solar technology.

28585 (SERI/SP—434-475) **Solar market studies: review and comment.** Vories, R.; Strong, H. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 59p. NTIS, PC A04/MF A01.

This report summarizes and comments on relevant solar energy market surveys and related studies to provide a basis for determining areas requiring additional research and possible policies and actions to aid in rapid adoption of solar technologies. Thirty-two studies are discussed. The first 19 studies directly assess the market for residential use of solar domestic hot water, space, and pool heating. Studies 20 and 21 inspect energy conservation surveys. Studies 22 and 23 examine the financial incentives and financial institutions in the expanding solar market. Study 24 considers energy and low-income people. Studies 25 and 26 assess market sizes for photovoltaic systems and wind machines. Studies 27 to 30 are not surveys per se, but represent secondary source and modeling efforts to gain understanding of the solar marketplace. Studies 31 and 32 present the Canadian perspective on the market feasibility of solar energy systems. Many of the studies contained flaws of concept and/or method to a degree that would bring into question the credibility of individual findings but, taken as an aggregrate, they provide a useful compendium of opinion about present and potential solar energy users.

28586 **Institutional barriers to solar energy: early HUD demonstration experiences.** Mara, G.; Engel, D. *Sol. Law Rep.;* 1: No. 6, 1094-1117(Mar 1980).

After briefly describing the Residential Solar Demonstration Program of HUD, several of the program experiences are discussed. The HUD program found that, in practice, most institutions presented only minor problem for active solar heating and cooling of homes. Demonstration experiences suggest solutions to problems which may arise outside the program, particularly as solar applications other than heating and cooling becomemore widespread. The HUD program will continue to study institutional problems for the program's passive solar grants and will focus on areas like the cities, where institutional concerns are more complex.

28587 **Federal legislation: abstracts.** *Sol. Law Rep.;* 1: No. 6, 1129-1226(Mar 1980).

Abstracts of federal and state legislation pertaining to solar energy are listed. (SPH)

28588 **Federal legislation: abstracts.** *Sol. Law Rep.;* 1: No. 4, 811-874(Nov 1979).

28589 **Land use law and solar technology: a synergistic relationship.** Hayes, G.B. (Environmental Law Inst., Washington, D). pp 217-219 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

The impact of new and existing land use laws of the development of solar technology is explored. Areas of particular significance and controversy include the problem of aesthetic restrictions that prevent collectors, and the lack of guarantees of access to sunlight once collectors are installed. (MHR)

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 28801

28590 (DOE/CH/00178—T1) **Thin film polycrystalline silicon solar cells. Quarterly technical progress report No. 2, 1 January 1980-31 March 1980.** Sarma, K.R.; Rice, M.J.; Legge, R.; Ellis, R.J. (Motorola, Inc., Phoenix, AZ (USA)). Jun 1980. Contract AC02-77CH00178. 41p. NTIS, PC A03/MF A01.

During this second quarter of the program, data on the effects of trace amounts (ppM level) of oxygen on the $MoSi_2$ substrate separation layer have been refined. Analysis of the composit substrate process has indicated that its complexity and expense are too great for practical development; as a result of this, and continued success with Mo substrates, efforts on composite substrates have been discontinued. By extensive operation of the semicontinuous plasma deposition system, operational characteristics have been further defined, permitting requirements for designing a truly continuous microcrystalline silicon film deposition system to be determined. Gas chromatography has been used to characterize the silicon deposition process using the silicon bearing gases $SiCl_4$, $SiHCl_3$, and SiH_2Cl_2; in all cases, deposition efficiency was found to be higher when using plasma than with conventional CVD. Solar cell fabrication and evaluation efforts have indicated that silicon films separated from Molybdenum substrates can yield cells up to 12.8% efficiency under AM1 illumination, and with average efficiencies above 11%.

28591 (DOE/CH/00178—T2) **Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Quarterly technical progress report No. 2, January 1, 1980-March 31, 1980.** Storti, G.; Regnault, W.; Johnson, S.; Lin, H.C.; Armstrong, R.W. (Solarex Corp., Rockville, MD (USA)). 1980. Contract AC02-77CH00178. 96p. NTIS, PC A05/MF A01.

Design modifications were made to incorporate thermocouples into the polysilicon casting furnace to allow for the constant monitoring of the temperature profile during the casting process. A source of metallurgical grade (MG) silicon was chosen and the material was prepared by grinding the large pieces into powder. The uniformity of the feedstock was ascertained by optical emission spectrograph analysis of three random samples of the feedstock. A total of sixteen casting runs were made this quarter; Union Carbide CMG graphite was found to be the most suitable crucible material. Solar cells were fabricated from the successful castings (five 100% SG, and two containing 1% and 5% MG silicon, respectively). The average efficiency from the first SG ingot was 10.4% AM0 (in excess of 12% AM1). In general, solar cells fabricated from the top and bottom of the ingots exhibited better overall characteristics. The addition of MG silicon to the casting caused a large degradation in both light and dark I-V characteristics. The dark current tended to be dominated almost entirely by the space-charge component in these castings. A new method was developed which eliminates temperature scanning in DLTS measurements by incorporating a spectrum analyzer into the system; results are in good agreement with published data. Efforts were directed toward decreasing the spot size of the scanning photoresponse system from 60 μm to 5 μm. Successful scans were made on a single crystal cell having a large shunt resistance. Electron channelling patterns were obtained for all crystallographic directions in polysilicon material and were assembled into a composite [001]-[111] standard triangle; measurement results are presented. Preliminary x-ray topographs were obtained for grains 1 and 2 in solar cell 1-1 using the asymmetrical crystal topography technique; results are discussed.

28592 (DOE/ET/23002—T3) **Polyacetylene, (CH)/sub x/, as an emerging material for solar cell applications. Second quarterly**

technical progress report, July-September 1979. Heeger, A.J.; MacDiarmid, A.G. (Pennsylvania Univ., Philadelphia (USA)). 1979. Contract AC04-79ET23002. 36p. NTIS, PC A03/MF A01.

As of the starting date of this contract, a variety of rectifying junctions had been fabricated using doped and undoped (CH)/sub x/. Schottky diodes formed between metallic AsF_5-doped (CH)/sub x/ and n-type semiconductors indicate high [CH(AsF_5)/sub y/]/sub x/ electronegativity. The p-type character of undoped trans-(CH)/sub x/ was confirmed by Schottky barrier formation with low work function metals. An undoped p-(CH)/sub x/:n–ZnS heterojunction solar cell has been demonstrated with open circuit photovoltage of 0.8 V. These results point to the potential of (CH)/sub x/ as a photosensitive material for use in solar cell applications. The devices fabricated in initial experiments fall into three categories: 1) Schottky diodes utilizing heavily doped (CH)/sub x/ as a metallic electrode on a variety of n-type semiconductors, 2) Schottky diodes utilizing undoped (CH)/sub x/ as a p-type semiconductor on which metallic contacts are placed, and 3) p-n heterojunction diodes formed at the inferface of undoped p-type (CH)/sub x/ on n-ZnS. Progress is reported. (WHK)

28593 (DOE/ET/23010—17) **Cuprous oxide photovoltaic cells. Fourth quarterly technical progress report, January 9-April 8, 1980.** Trivich, D. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 1980. Contract AC04-79ET23010. 37p. NTIS, PC A03/MF A01.

The previous work on this project was devoted to a study of MIS cells and heterojunction cells with Cu_2O. In particular the junctions were studied by Auger techniques to detect possible chemical changes at the interface. It was found that some preparation conditions could produce heterojunctions without chemical degradation. In the last quarter, work was initiated on the effect of impurities in the starting Cu on the properties of the Cu_2O and Cu_2O solar cells. Methods of measuring diffusion length were explored. In this report a further examination of impurities in the Cu is presented. Some additional details on the CdO/Cu_2O heterojunction are given. The measurement of diffusion length by a photocurrent method is described and some results are given.

28594 (DOE/ET/23040—2) **Amorphous thin films for solar cell application. Quarterly report No. 2, July 1-September 30, 1979.** Jonath, A.D.; Crowley, J.L.; MacMillan, H.F.; Anderson, W.W.; Junga, F.A.; Kooi, C.F.; McNab, T.K.; Scoble, W.R.; Thornton, J.A. (Lockheed Palo Alto Research Labs., CA (USA)). Oct 1979. Contract AC03-79ET23040. 42p. NTIS, PC A03/MF A01.

Research on the fabrication of efficient amorphous silicon solar cells is reported. Work on the deposition of a-Si:H films by sputtering is described. Other areas under scrutiny include (a) degree and effect of oxygen and/or argon incorporation into the films, (b) dopant transfer from target to films, (c) dopant and alloy ion-implantation effects, and (d) film annealing behavior. Results to date are presented. (WHK)

28595 (DOE/ET/23108—1) **Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Quarterly report No. 1, May 31, 1979-August 31, 1979.** Redfield, D. (RCA Labs., Princeton, NJ (USA)). Sep 1979. Contract AC01-79ET23108. 16p. NTIS, PC A02/MF A01.

Fundamental limitations on the efficiency of Si solar cells are analyzed theoretically and experimentally. Emphasis is on mechanisms limit V/sub oc/ because that is the parameter for which the greatest discrepancy exists between observation and previous theory. Analyses of heavy-doping effects and doping gradient effects show that past treatments of such effects have been inadequate. It is shown that the inclusion of Auger processes - previously neglected - is essential, and produces a fundamental change in the diffusion-theory expression for the saturation current J/sub o/, which dominates V/sub oc/. An improved method is given for evaluating J/sub o/ and a calculation based on this method shows that past estimates of band-gap narrowing by other methods are seriously in error.

28596 (DOE/ET/23108—2) **Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Quarterly report No. 2, September 1-November 30, 1979.** Redfield, D. (RCA Labs., Princeton, NJ (USA)). Dec 1979. Contract AC01-79ET23108. 23p. NTIS, PC A02/MF A01.

The effects of Auger recombination on the saturation current density of heavily doped semiconductors are shown to be more far-reaching than was recognized, even in the previous Quarterly Report. The equation generally used to predict and evaluate the saturation current in Si junctions always becomes invalid in the heavily doped cases of interest. The new procedure for determining J/sub o/ that was developed in the last quarter has been improved in two ways that now permit the identification of qualitative trends in J/sub o/ in a significant manner. Experiments relating doping-gradient effects to surface properties of Si solar cells have provided new data on this relationship and have led to the development of a simple new method for evaluating antireflection (AR) coatings.

28597 (DOE/ET/32208—4) **Vacuum deposited polycrystalline silicon films for solar cell applications. Final report, 29 September 1978-30 September 1979.** Feldman, C.; Satkiewicz, F.G.; Blum, N.A. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Dec 1979. Contract ET-78-A-03-2208. 80p. NTIS, PC A05/MF A01.

The DOE goal of obtaining low-cost, 10% efficient solar cells was approached through the development of a potentially all-vacuum fabrication process incorporating vacuum deposited, thin-film, polycrystalline silicon. Experimental devices were constructed in layers as follows: alumina substrate/TiB_2 bottom electrode/p-type polycrystalline silicon film/diffused silicon n-region/Ti-Ag electrode. An essential feature of this design is the TiB_2 bottom electrode which is stable with respect to silicon up to 1200°C and remains conducting after the silicon deposition. Grain growth, film composition and interfacial analyses, and photovoltaic characteristics were investigated using secondary-ion mass spectrometry (SIMS), X-ray diffraction and conventional electronics measurements techniques. Average grain diameters in the films parallel to the substrate were 5 μm. Phosphorus was diffused into the silicon film using standard techniques to create n-p junctions. Al, Ti, and Ti/Ag electrodes were used as top contacts to the n-type layer. Typical of the best photovoltaic responses from small grained devices without antireflection coating or electrode geometry optimization were V/sub oc/ = 0.26V, J/sub sc/ = 16 mA/cm², efficiency 2.2% and fill factor 0.54. The highest V/sub oc/ observed to date is 0.38V; the highest efficiency is 2.6%. Carrier concentrations were obtained by both Hall effect and SIMS measurements; diffusion lengths were determined by the short-circuit current vs incident light wavelength method. SIMS was used extensively in the examination of interactions at each interface. Results are presented and discussed.

28598 (DOE/JPL/954339—80/16-17) **Evaluation of selected chemical processes for production of low-cost silicon: Phase III. Silicon Material Task, Low-Cost Solar Array Project. Sixteenth/seventeenth quarterly progress report, July-December 31, 1979.** Blocher, J.M. Jr.; Browning, M.F. (Battelle Columbus Labs., OH (USA)). 7 Mar 1980. Contract NAS-7-100-954339. 38p. NTIS, PC A03/MF A01.

The method under development for the production of semiconductor grade silicon is based on the zinc vapor reduction of silicon tetrachloride in a fluidized bed of seed particles. Construction of the PDU was completed during the report period, the fluidized-bed reactor was coated internally with silicon/SiC, and the operation of several systems was checked out. However, problems with the zinc feed system, unrelated to its basic operability, delayed introduction of zinc vapor to the PDU. At the end of the report period, the zinc feed system stood ready for tests of the control of zinc vapor feed rate by regulation of r.f. induction heating directly coupled to the liquid zinc. A study of the zinc distribution in miniplant silicon products containing zinc at the 300 and 3000 ppM levels suggests that the occlusion of zinc is caused by zinc mist entrained from the vaporizer, and it should be possible to drive the level to below 300 ppM by proper equipment design and process control.

28599 (DOE/JPL/954355—80-1) **Large area silicon sheet by EFG. First quarterly report, Jan 1-March 31, 1980.** (Mobil Tyco Solar Energy Corp., Waltham, MA (USA)). 1 Jun 1980. Contract NAS-7-100-954355. 56p. NTIS, PC A04/MF A01.

Operation of Furnace 3A in a multiple mode with three 10 cm cartridges and with melt replenishment has been demonstrated for the first time. Detailed characterization of the temperature field of the 10 cm cartridge has been started in order to assist in work on improving cartridge performance and in implementation of automatic controls. Development of the 10 cm cartridge system in Furnace 17 has proceeded with efforts to improve high speed performance and to study means by which to improve ribbon quality. Reliable growth has been achieved up to speeds as high as 4.0 cm/min, and cell efficiencies of above 10% (AM1 and AR coated) have been demonstrated for this ribbon. The study of ambient influences on growth conditions and quality has continued in Furnace 18 with additional growth with CO_2 present. The photovoltaic performance of ribbon grown with and without CO_2 has been investigated, and differences in light enhancement characteristics are observed as a function of the type of processing used, viz., CVD as compared to PH_3.

28600 (DOE/JPL/954847—80/7) **Phase 2 of the automated array assembly task of the Low-Cost Silicon Solar Array Project. Technical quarterly report No. 6, 1 October 1979-31 December 1979.** Coleman, M.G.; Pryor, R.A.; Sparks, T.G.; Saltzman, D.L. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-954847. 40p. NTIS, PC A03/MF A01.

The ion implantation, metallization, and plasma etching processes are highlighted. Replacement of the hydrocarbon vacuum pump oils in the ion implanter with perfluorinated polyether pump oils has decreased, but not eliminated the formation of a carbonaceous surface layer on implanted wafers. Simulated unanalyzed beam ion implantation of boron for p-on-n cell fabrication has shown

preliminary favorable results, showing better performance than control analyzed beam boron implants. An ion milling machine was adapted for true unanalyzed beam implants. The results show that high quality solar cells can be made with a high current unanalyzed ion beam. A new plasma etching unit has been obtained for patterning experiments. Preliminary experiments have been run. A polymerization effect of reactant gases has been observed, presenting a control problem. Changes in mask materials and gas compositions have been shown to eliminate this problem with the plasma patterning process. A re-evaluation of electroless nickel plating bath compositions has led to a new bath which gives successful plating without the formation of an oxide layer on the silicon surface observed with the previous baths. Low stress copper layers have been electroplated without the formation of an oxide layer on the silicon surface observed with the previous baths. Low stress copper layers have been electroplated over electroless nickel. The layers show suitable properties for solar cells. Cells have now been fabricated and heat treated with nickel-copper metallization. Nickel is shown to be a suitable barrier to copper diffusion into silicon.

28601 (DOE/JPL/954886—80/10) **LSA large area silicon sheet task continuous liquid feed Czochralski growth. Quarterly report, January-March 1980.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Apr 1980. Contract NAS-7-100-954886. 22p. NTIS, PC A02/MF A01.

The purpose of this specific phase of the continuous liquid feed program is the design and development of equipment and processes in order to demonstrate the continuous growth of crystals, by use of the Czochralski method, suitable for producing monocrystalline silicon for use in solar cells. This involves the growth of at least 150 kgs of monocrystalline silicon ingots, 150 mm in diameter, obtained from a single growth container. Our approach to meeting this goal is to develop a furnace with continuous liquid replenishment to the growth crucible. The most significant event occurring this quarter was the repeated demonstration of the polyrod feed mechanism, providing continuous melt replenishment to the meltdown chamber, subsequent transfer of this melt, and the simultaneous growth of silicon ingots in the growth chamber.

28602 (DOE/JPL/955164—79/4) **Development of economical improved thick film solar cell contact. Extension final report, April-December 1979.** Ross, B. (Bernd Ross Associates, San Diego, CA (USA)). Dec 1979. Contract NAS-7-100-955164. 107p. NTIS, PC A06/MF A01.

In the second half of the investigation of all metal screened electrodes, the focus was on base metal pastes in addition to further work with the silver systems. Contact resistance measurements were refined. A facility allowing firing in hydrogen and other atmospheres was acquired. Several experiments were made applying screenable pastes to solar cells. Doping investigations emphasized eutectic alloys reduced to powders. Metal systems were reviewed. A previously published vapor pressure curve for silver fluoride was corrected. Base metal experiments were done with nickel and copper using lead and tin as the frit metals. Severe adhesion problems were experienced with hydrogen atmospheres in all metal systems. A two step firing schedule was devised based upon experimentation which gave evidence that the silver fluoride-silicon dioxide reaction was modified by the presence of hydrogen. It was found that nitrogen prefiring allowed the silver fluoride dissociation and oxide removal without causing catastrophic oxidation of the base metal powders. The subsequent hydrogen firing step reduced oxides tht had formed and gave the proper sintered structure. Electrodes were coherent, adherent, and solderable in both nickel lead and copper lead systems. Towards the end of the contractual period aluminum-silicon and aluminum-germanium eutectic doping additions to copper pastes were tried on 2 1/4" diameter solar cell back contacts, both with good results (eta = 9.4% AM1 uncoated).

28603 (DOE/JPL/955298—80/2) **High resolution, low cost solar cell contact development. Final report.** Mardesich, N. (Spectrolab, Inc., Sylmar, CA (USA)). Dec 1979. Contract NAS-7-100-955298. 50p. NTIS, PC A03/MF A01.

Experimental work demonstrating the feasibility of the MIDFILM process as a low-cost means of applying solar cell collector metallization was completed during this contract. Cell efficiencies of above 14% (AM1, 28°C) were achieved with fritted silver metallization. Environmental tests suggest that the metallization is slightly humidity sensitive and degradation is observed on cells with high series resistance. The major yield loss in the fabrication of cells was due to discontinuous grid lines, resulting in high series resistance. Standard lead-tin solder plated interconnections do not appear compatible with the MIDFILM contact. Copper, nickel and molybdenum base powder were investigated as low-cost metallization systems. The copper based powder degraded the cell response. The nickel and molybdenum base powders oxidized when sintered in the oxidizing atmosphere necessary to ash the photoresin.

28604 (DOE/JPL/955382—79/5) **Low-Cost Solar Array Project. Task I. Silicon material: investigation of the hydrogenation of $SiCl_4$. Fifth quarterly report.** Mui, J.Y.P. (Massachusetts Inst. of Tech., Cambridge (USA)). 3 Jul 1980. Contract NAS-7-100-955382. 26p. NTIS, PC A03/MF A01.

Reaction kinetic measurements on the hydrochlorination of $SiCl_4$ and mg silicon metal in the presence of a copper catalyst were last reported as a function of reaction temperature, reactor pressure and $H_2/SiCl_4$ ratio, 3 $SiCl_4$ + 2 H_2 + Si → 4 $SiHCl_3$. The same reaction was repeated at a lower catalyst loading of 2 wt%. In the presence of 2 wt% cuprous chloride (based on silicon metal), the hydrochlorination reaction rate is doubled to give about the same performance as those obtained at a higher copper catalyst loading. The effect of particle size distribution of the mg silicon metal on the hydrochlorination reaction rate was studied. Reaction kinetic measurements were made on 150 x 400 mesh Si and on 32 x 65 mesh Si in addition to the standard 65 x 150 mesh Si used in previous studies. Results of these experiments show that the reaction rate is essentially independent of the silicon metal particle size. Thus, the reaction occuring on the Si metal surface is the rate-determining step. Mass transfer via diffusion of reactants and product is not rate-limiting. A plausible mechanism of the hydrochlorination reaction is discussed.

28605 (DOE/SERI—8119-3/2) **Sequential purification and crystal growth for the production of low cost silicon substrates. Quarterly technical progress report No. 2, 1 January 1980-31 March 1980.** Liaw, M.; D'Aragona, F.S. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). May 1980. Contract AC02-77CH00178. 36p. NTIS, PC A03/MF A01.

The objective of this program is to identify and develop low cost processing for fabricating large grain size polycrystalline silicon substrates. Metallurgical grade silicon (MG-Si) which is low cost and abundant for industrial usage was chosen as starting material. However, MG-Si cannot be used directly as substrates for solar cell fabrication; the further purification and recrystallization of MG-Si are needed. The conventional method of purifying MG-Si requires the conversion of Si to gaseous chlorosilanes. Chlorosilanes are purified by distallation. The purified chlorosilanes are then converted back to elemental silicon using a chemical vapor deposition process. Purified polysilicon requires recrystallization to become single crystals or large grain polycrystalline form for electronic device or solar cell applications. The techniques being studied under this program use direct methods for the purification of MG-Si. The process uses sequential steps of purification followed by crystal growth. The steps of sequential purification include: (1) leaching of MG-Si charge, 2) phase separation of non-soluble impurities from molten silicon, 3) reactive gas treatment of molten silicon, 4) liquid-liquid extraction (called slagging), and 5) impurity redistribution using ingot pulling. All the purification steps are performed in a consecutive manner using a crystal puller with the exception of step (1). The purified ingots will be in a desired ingot dimension and further recrystallization is not necessary. In this quarterly period the study of the purification by (1) reactive gas treatment, and 2) slagging was completed. Selection of reusable crucible has also been made. Progress is reported.

28606 (DSE—4042-3) **Cadmium sulfide-copper sulfide: heterojunction cell research. Quarterly progress report-3, March 1, 1979-June 1, 1979.** (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Aug 1979. Contract EG-77-C01-4042. 69p. NTIS, PC A04/MF A01.

Progress has been made on improving the photon efficiency of the planar CdS/Cu_2S solar cell. Current in excess of 20 mA/cm^2 have been achieved. Mixed sulfide solar cells responsive to heat treatment are now being produced. The morphology of the Cu_2S/CdZnS junction has been examined and found to be significantly different than the morphology on CdS/Su_2S cells. Efficiencies measured under ELH simulation approaching 8% have been achieved. Work in the analytical task has focused on establishing the experimental techniques to study the trap levels in the CdS and to provide a working model for the voltage instabilities in some (CdZn)S/Cu_2S cells. Cells under roof top exposure continue to be monitored.

28607 (DSE—4042-T42) **Development of copper sulfide/cadmium sulfide thin film solar cells. First technical progress report, 13 July 1979 to 12 October 1979.** Szedon, J.R.; Shirland, F.A.; Stoll, J.A.; Dickey, H.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 14 Feb 1980. Contract EG-77-C-01-4042. 36p. NTIS, PC A03/MF A01.

Preparation of CdS films by evaporation from a single graphite source, as generally used by the Institute of Energy Conversion (IEC) group at the University of Delaware, has been implemented. Previously at Westinghouse, four evaporation sources were used to permit uniform coverage of large area substrates. The graphite source used in this period is somewhat smaller than the IEC design to permit accommodation to the heater geometry currently available. Initial efforts with the single source evaporation have been on characterizing the thickness profiles of the deposited films. This is needed to permit selection of conditions for obtaining films of about 30μm thickness over the central 4 cm x 4 cm area of the substrate. Barrier processing according to the details of IEC method has been

used on four-source CdS films. To date the best cells have only been about 1% efficient. Low short circuit current density values (~ 5 mA/cm$_2$) have been the biggest problem. Annealing in 6% H_2/Ar mixtures at 170°C after electrode grid evaporation generally has resulted in reduced values of J/sub sc/. Plans for the next period include the use of single source films for cell processing and the use of small area diode arrays to map cell performance parameters as a function of position on the substrate.

28608 (LBL—10791) **Research on Cu/sub x/S/(Cd,Zn)S photovoltaic solar energy converters. Final report, March 1977-September 1979.** Chin, B.L.; Peterson, T.M.; Dahmen, U.; Seshan, K.; Sindelar, L.E.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 119p. NTIS, PC A06/MF A01.

The objective of this program was to better understand the factors affecting the operation of CdS/Cu/sub x/S and (Cd,Zn)S/Cu/sub x/S photovoltaic cells. The approach was to systematically study the single crystal heterojunction so as to eliminate the complicating effects of grain boundaries. Single crystal CdS and (Cd,Zn)S thin films were deposited onto both GaAs and Ge substrates by a hot-wall vacuum deposition technique. These grown films were studied using x-ray diffraction, SEM-EDAX, TEM and Hall Effect experiments. Information concerning the effects of varying processing parameters on the chemical and structural nature of the deposited films was obtained. Detailed TEM studies revealed the presence of different dislocation structures which can affect the cell performance. Heterojunctions with Cu/sub x/S were formed by the solid-state ion-exchange method and reactive sputtering (performed by the Lawrence Livermore Laboratory). Current-voltage and spectral response measurements of these cells were performed. The relationship between structural information and cell operation was studied. Suggestions for further work are outlined.

28609 (SAN—1202-78/1) **Thin films of gallium arsenide on low-cost substrates. Quarterly technical progress report No. 5 and topical report No. 1, October 2, 1977-December 31, 1977.** Ruth, R.P.; Dapkus, P.D.; Dupuis, R.D.; Johnson, R.E.; Manasevit, H.M.; Moudy, L.A.; Yang, J.J.; Yingling, R.D. (Rockwell International Corp., Anaheim, CA (USA)). Jan 1978. Contract EY-76-C-03-1202. 31p. NTIS, PC A03/MF A01.

The metalorganic chemical vapor deposition (MO-CVD) technique has been applied to the growth of thin films of GaAs and GaAlAs on inexpensive polycrystalline or amorphous substrate materials (primarily glasses and metals) for use in fabrication of large-area low-cost photovoltaic device structures. Trimethylgallium (TMG), arsine (AsH_3), and trimethylaluminum (TMAl) are mixed in appropriate concentrations at room temperature in the gaseous state and pyrolyzed at the substrate, which is heated in a vertical reactor chamber to temperatures of 725 to 750°C, to produce the desired film composition and properties. The substrates used during the quarter included composite structure of sputtered Mo films on various glasses, composites of CVD (GeH_4 pyrolysis) Ge films of these same glasses, large-grained annealed bulk Mo sheet, large-grained bulk polycrystalling GaAs, and one grade of high-purity high-density graphite. The glasses used were Corning Codes 0317, 7059, and 1723, with most of the composites involving the 0317 type. Preliminary results with graphite substrates were not encouraging, but the available substrates used were not of adequate purity or surface quality. Results are discussed. (WHK)

28610 (SAN—1202-78/2) **Thin films of gallium arsenide on low-cost substrates. Quarterly technical progress report No. 6 and topical report No. 2, January 1, 1978-April 1, 1978.** Ruth, R.P.; Dapkus, P.D.; Dupuis, R.D.; Campbell, A.G.; Johnson, R.E.; Manasevit, H.M.; Moudy, L.A.; Yingling, R.D. (Rockwell International Corp., Anaheim, CA (USA)). Apr 1978. Contract EY-76-C-03-1202. 43p. NTIS, PC A03/MF A01.

The metalorganic chemical vapor deposition (MO-CVD) technique has been applied to the growth of thin films of GaAs and GaAlAs on inexpensive polycrystalline or amorphous substrate materials (primarily glasses and metals) for use in fabrication of large-area low-cost photovoltaic device structures. Trimethylgallium (TMG), arsine (AsH_3), and trimethylaluminum (TMAl) are mixed in appropriate concentrations at room temperature in the gaseous state and pyrolyzed at the substrate, which is heated in a vertical reactor chamber to temperatures of 725 to 750°C, to produce the desired film composition and properties. The substrate materials used for experimental studies during the quarter included several grades of graphite (from two different manufacturers), commercial-grade Al alloy sheet, large-grained annealed Mo sheet, sputtered Mo films on Corning Code 0317 glass, uncoated 0317 glass, large-grained polycrystalline alumina (Coors Vistal 5), and large-grained bulk polycrystalline GaAs. Results indicted graphite to be a suitable substrate for GaAs film growth by MO-CVD, although some adherence problems were uncountered with improperly prepared graphite surfaces. No major differences were observed for GaAs growth on the various graphites; films ~ 10 μm thick exhibited apparent grain sizes (indicated by dimensions of surface features) in the 2 to 5 μm range. Annealed Mo sheet substrate having relatively large grain structure did not appear to produce correspondingly large grains in deposited polycrystalline GaAs films. Results are reported in detail. (WHK)

28611 (SAN—1285-T2) **Thin films of silicon on metallurgical silicon substrates. Final report, 1 September 1976-30 September, 1979.** Chu, T.L. (Southern Methodist Univ., Dallas, TX (USA)). Sep 1979. Contract EY-76-C-03-1285. 98p. NTIS, PC A05/MF A01.

The principal approach used in this work is the deposition of a silicon film of controlled thickness and dopant distribution on a purified metallurgical silicon substrate. Efforts have been directed to (1) the purification of metallurgical silicon, (2) the preparation of metallurgical silicon substrates, (3) the deposition and characterization of silicon films on metallurgical silicon substrates, (4) the properties of polycrystalline silicon p-n junctions on metallurgical silicon substrates, (5) the fabrication and characterization of silicon solar cells on purified metallurgical silicon substrates, (6) the investigation of stability of thin film polycrystalline silicon solar cells, and (7) the reduction of the electrical effects of grain boundaries. A number of significant results have been obtained. Metallurgical silicon has been purified by a low cost technique, acid-extraction and phosphorus pentoxide treatment, to yield materials suitable for substrate purposes. Recrystallization techniques have been developed to produce large grain silicon sheet supported on graphite. Silicon films of controlled thickness and dopant distribution have been deposited on metallurgical silicon substrates, and the properties of silicon films and epitaxial p-n junctions have been investigated in detail. Polycrystalline silicon solar cells have been fabricated, and their properties including current-voltage characteristics, spectral response, minority carrier diffusion length, dopant profile, and stability, have been characterized in detail. The properties of grain boundaries in polycrystalline silicon solar cells have been investigated by photoresponse scan and EBIC techniques.

28612 (SAND—79-2270C) **Gallium arsenide photovoltaic dense array for concentrator applications.** Cape, J.A.; Harris, J.S. Jr.; Wiczer, J.J. (Rockwell International Corp., Thousand Oaks, CA (USA). Electronics Research Center; Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-800604—32). NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

This paper reports on the design, fabrication and testing of a dense array consisting of 16 overlapped linear modules each containing 16 contiguous 1 cm X 1.25 cm GaAs concentrator cells in a row. The overlapping is done so that only active cell area is presented to the concentrated sunlight. The array presents a frontal area of 320 cm^2 and is designed to yield a system output of ~ 230 volts at 25 to 25 amps at 1000 SUNs. The results of tests carried out at Sandia's Central Receiver Test Facility at concentrations up to 1500 SUNs and temperatures to 185°C will be presented.

28613 (SAND—80-0587C) **US National Photovoltaics Program and applications experiments in the intermediate sector.** Rios, M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01.

A brief overview of the US National Photovoltaics Program is presented. The Department of Energy (DOE) commercial readiness goals for photovoltaics technology are summarized and the role of the national labs, research centers, and institutes in the strategy for achievement of these goals is outlined. Some examples of the flat-plate and concentrator photovoltaics experiments that are under construction through the DOE Program Research and Development Announcements (PRDAs) are discussed. These experiments are intended to establish system feasibility and demonstrate the applicability of photovoltaics as an alternative energy source in the intermediate sector (industrial, commercial, and agricultural). Installed system costs for the proposed PRDAs are given and concentrator technology requirements for achievement of DOE commercial readiness goals are presented. Some new DOE activities intended to further assist the commercialization of photovoltaics are briefly outlined. These new activities include the completion of an International Photovoltaics Plan.

28614 (SAND—80-1569C) **Gallium arsenide photovoltaic dense array for concentrator applications.** Wiczer, J.J.; Cape, J.A.; Harris, J.S. Jr. (Sandia National Labs., Albuquerque, NM (USA); Rockwell International Corp., Thousand Oaks, CA (USA). Electronics Research Center). 1980. Contract AC04-76DP00789. 16p. (CONF-800719—6). NTIS, PC A02/MF A01.

From International symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (28 Jul 1980).

An array of 256 densely packed gallium arsenide (GaAs) solar cells was designed, fabricated and tested to explore the feasibility of operating photovoltaic subsystems at solar central receiver facilities. The design goals, fabrication processes, and observed test results for such a photovoltaic array are reported.

28615 (SERI/PR—0-8274-2) **Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 2, 25 December 1979-24 March 1980.** D'Aiello, R.V.; Robinson, P.H. (RCA Labs., Princeton, NJ (USA)). Apr 1980. Contract EG-77-C-01-4042. 25p. NTIS, PC A02/MF A01.

Experiments were continued on the material characterization and epitaxial growth of solar-cell structures on three grades of a candidate low-cost upgraded metallurgical grade (UMG) silicon substrate. Enough epitaxial solar cells to characterize the baseline performance of cells on these three substrate grades were fabricated and tested. With a 15-μm-thick epitaxial structure grown on the purest form of UMG substrate, an average cell AM-1 efficiency of 12.5% was obtained. Similar structures grown on the less pure multicrystalline substrate grades result in efficiencies of 9 to 10.3%. A novel way of slicing these substrates which exposes larger grain areas and results in higher cell efficiencies is described. The application of slow-cooling and gettering to the growth of thicker (equal to or greater than 50 μm) epitaxial solar-cell structures was found ineffective. The use of alternate silicon gas sources was explored by using silane for the growth of cell structures. The initial results are encouraging and will be further pursued.

28616 (SERI/PR—8274-1) **Low-cost epitaxial techniques for solar-cell fabrication. Quarterly technical progress report No. 1, September 26, 1979-December 24, 1979.** D'Aiello, R.V.; Robinson, P.H. (RCA Labs., Princeton, NJ (USA)). Jan 1980. Contract EG-77-C-01-4042. 27p. NTIS, PC A03/MF A01.

During the frst quarter, a candidate low-cost silicon substrate, designated upgraded metallurgical grade (UMG) silicon, was obtained. The electrical, physical, and structural properties of three grades of this material were measured. An initial epitaxial growth technique was standardized and qualified for application to the growth of diagnostic and solar-cell structures. Such structures were grown on the three UMG grades of substrates and the properties of these layers were compared to those of the substrates. It was generally found that the defect density in the epitaxial films was lower than in the substrates, but greater aerial variation was observed for the less pure, multicrystalline grades of substrates. Solar cells were fabricated in epitaxial structures grown on all three UMG grades of substrates. An AM-1 efficiency of 12.9% was obtained when the purest substrate grade was used, and 10.3% was achieved with a 15-μm-thick film grown on the material of lowest purity.

28617 **Solar energy system.** Campbell, W.P. III. US Patent 4,172,740. 30 Oct 1979. Filed date 28 Mar 1978. 10p.

A system for extracting energy from the sun's rays including a bank of solar energy cells which generate electrical current when exposed to the rays of the sun, immersed in a bath of liquid formed to serve as a lens, concentrating the sun rays on the cells, and transmitting heat away from the cells. The cells are shaped so as to cause a trapping effect of radiation incident thereon. The improved solar converting unit additionally includes a method for preheating the interior thereof. The converting unit is preferably equipped with light gathering and focusing means thereby providing coherent optically output.

28618 **Solar energy converter.** Williams, G.J. (to Cornell Research Folundation). US Patent 4,094,703. 13 Jun 1978. Filed date 30 Dec 1976. 12p.

An improved solar energy converter is disclosed which comprises a plurality of electrically conductive, photoemitting electrodes geometrically arrayed so that light will strike only one surface of each to produce electron emission. The electrodes are in a spaced, generally parallel relationship so that electrons emitted by the illuminated surface of one electrode will travel to, and be collected by, a non-illuminated surface of one electrode will travel to, and be collected by, a non-illuminated surface of a next adjacent electrode. A vacuum surrounds the electrodes so that only space conduction occurs. Each electrode has one surface which acts as an electron collector, or anode, and thus each pair of adjacent electrode surfaces is analagous to a voltage cell, the plurality of electrodes forming a solar energy battery.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 28574, 28672, 29240

28619 (COO—4388-11) **Liquid fuels production from biomass. Progress report No. 11, January 1-March 31, 1980.** Levy, P.F.; Sanderson, J.E.; Wise, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). 1980. Contract EG-77-C-02-4388. 48p. NTIS, PC A03/MF A01.

It was found that marine algae could be converted to higher aliphatic organic acids and that these acids could be readily removed from the fermentation broth by membrane or liquid-liquid extraction. It was then proposed to convert these higher organic acids via Kolbe Electrolysis to aliphatic hydrocarbons, which may be used as a diesel fuel. A coenzyme M analogue, 2-bromoethanesulfonic acid, has been shown to be an effective suppressor of methane in nonsterile anaerobic fermentation of cellulosic substrates. Preliminary experiments have also been completed utilizing corn meal which 2-bromoethanesulfonic acid and carbon monoxide were both found to be effective methane suppressors. An analysis of the energy outputs and requirements for the production of liquid hydrocarbon fuel from corn has been performed. As a means of expanding the number of potential substrates, pretreatment schemes are being investigated. An analytical scheme for determining composition of biomass materials has been devised. A tapered auger device has been designed and built which has been demonstrated on the bench to be effective for adding substrate and removing residue in a continuous manner from a fixed packed bed fermenter. A solvent extractor system using kerosene as the nonaqueous phase has been constructed and is currently in operation in series with the 300-liter fixed packed bed fermenter. The electrolytic oxidation of organic acids produced in the 300-liter fixed packed bed fermenter is operating with a favorable energy balance of 6/1 based on the applied potential. The liquid-liquid extractor system is operating in line withy 300-liter fixed packed bed fermenter. An economic analysis for a 1000 ton per day plant has been performed and has been improved and updated based on additional experimental results.

28620 (DOE/CS/20100—T1) **Evaluation of mixing systems for biogasification of municipal solid waste.** Swartzbaugh, J.T.; Smith, R.B. (Systems Technology Corp., Xenia, OH (USA)). 1979. Contract AC05-76CS20100. 80p. NTIS, PC A05/MF A01.

Two specially selected mixing systems were tested and evaluated to determine how effectively they could prevent the formation of fibrous mats and stringers during the anaerobic digestion of a slurried mixture of preprocessed municipal solid waste and sewage sludge to produce methane gas. The tests were conducted in a modified 10.7-m (35-ft) diameter, nominal 378,000-liter (100,000-gal) capacity concrete vessel in the Franklin, Ohio, environmental complex. Between August 1977 and September 1978, nine tests were conducted with 3:1 and 9:1 solid waste/sewage sludge ratios and with 4, 7, and 10 percent total solids in the feedstock. Though the microbial culture was healthy in most tests, the mixing systems were not effective in preventing excessive fibrous mat and stringer formations. These formations occurred because of the high cellulosic content of the feedstock. The test with the best energy recovery had a gas production of 805 liters/kg of volatile solids destroyed. However, the energy recovered was only 50 percent of the energy available in the solid waste, and only four times greater than the mixing energy expended for that test. The solids accumulations were generally the same for the two mixing systems when they had common test conditions. In all tests, the percent solids for the top level were higher than those for the middle and bottom levels. As the feed ratio and the percent solids in the feedstock were increased, this differential became progressively more pronounced. Moreover, the percent of volatile solids (in a given amount of total solids) for the top level became disproportionately higher than those for the other two levels.

28621 (DOE/ET/23066—4) **Improvement of yields and rates during enzymatic hydrolysis of cellulose to glucose. Final report, December 1, 1978-January 31, 1980.** Sundstrom, D.W.; Klei, H.E.; Coughlin, R.W. (Connecticut Univ., Storrs (USA)). Mar 1980. Contract ET-79-S-02-5141. 22p. NTIS, PC A02/MF A01.

The production of sugars by enzymatic hydrolysis of cellulose is a multistep process which includes conversion of the intermediate cellobiose to glucose by β-glucosidase. Aside from its role as an intermediate, cellobiose inhibits the endogluconase components of typical cellulase enzyme systems. Because these enzyme systems often contain insufficient concentrations of β-glucosidase to prevent accumulation of inhibitory cellobiose, this research investigated the use of supplemental immobilized β-glucosidase to increase yields of glucose. Immobilized β-glucosidase from Aspergillus phoenicis was produced by sorption on controlled-pore alumina with about 90% activity retention. The product lost only about 10% of the original activity during an on-stream reaction period of 500 hours with cellobiose as substrate; maximum activity occurred near pH 3.5 and the apparent activation energy was about 11 k cal/mole. The immobilized β-glucosidase was used together with Trichoderma reesei cellulase to hydrolyze cellulosic materials, such as Solka Floc, corn stover and exploded wood. Increased yields of glucose and greater conversions of cellobiose to glucose were observed when the reaction systems contained supplemental immobilized β-glucosidase.

28622 (DOE/PE/70048—T2) **Evaluation of processes for producing gasoline from wood. Final report.** (JBF Scientific Corp., Wilmington, MA (USA)). May 1980. Contract AC01-79PE70048. 50p. NTIS, PC A03/MF A01.

Three processes for producing gasoline from wood by pyrolysis have been investigated. Technical and economic comparisons among the processes have been made, based on a hypothetical common plant size of 2000 tons per day green wood chip feedstock. In order to consider the entire fuel production process, the energy and cost inputs for producing and delivering the feedstock were

included in the analysis. In addition, perspective has been provided by comparisons of the wood-to-gasoline technologies with other similar systems, including coal-to-methanol and various biomass-to-alcohol systems. Based on several assumptions that were required because of the candidate processes' information gaps, comparisons of energy efficiency were made. Several descriptors of energy efficiency were used, but all showed that methanol production from wood, with or without subsequent processing by the Mobil route to gasoline, appears most promising. It must be emphasized, however, that the critical wood-to-methanol system remains conceptual. Another observation was that the ethanol production systems appear inferior to the wood-to-gasoline processes. Each of the processes investigated requires further research and development to answer the questions about their potential contributions confidently. The processes each have so many unknowns that it appears unwise to pursue any one while abandoning the others.

28623 (DSE—3070-T1) **Energy sensitivity and variability analysis of Populus hybrid short-rotation plantations in northeastern United States. Final report.** Bowersox, T.W.; Blankenhorn, P.R. (Pennsylvania State Univ., University Park (USA). School of Forest Resources). 24 Oct 1979. Contract ET-78-G-01-3070. 113p. NTIS, PC A06/MF A01.

Production of biomass by corn-like plantations has been demonstrated by a number of researchers. These forest analogs of agronomic cropping systems have the potential to yield substantially more biomass per unit area than traditional forests. Care is needed in choosing the appropriate sites, species, spacing, and harvesting strategies. Opportunities for increased yields have been suggested for fertilization and irrigation. Utilization of the biomass from these dense plantations for energy was the focus of this study. Although the amount of energy potential of the biomass is important, the energy output must be greater than the energy input for biomass to have a positive benefit to society. Further, in order to completely evaluate the net energy of the system it is necessary to examine the energy out-to-in ratios on the basis of usable energy (for example, usable heat, process steam and electricity), as well as all of the energies expended in producing, harvesting, transporting and processing the biomass. The objective of this study is to establish and analyze the energy inputs for selected management strategies in order to evaluate the sensitivity and variability of the energy inputs in the net energy analysis, and based on the net energy analysis to recommend a management strategy that minimizes energy inputs while maximizing biomass yield for short-rotation systems of Populus spp. in the northeastern United States.

28624 (LA-UR—80-1426) **Micro-level land use impacts of bioconversion.** Parsons, V. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-26. 6p. (CONF-800567—2). NTIS, PC A02/MF A01.

From International symposia alternative energy sources and technology; Montreal, Canada (28 May 1980).

The energy crisis has prompted research and development of renewable energy sources, among which are the bioconversion technologies. Crops, crop residues, manure and other organic wastes are potential sources of liquid, solid and gaseous fuels. These feedstocks originate on the farm or in the forest and therefore are land intensive. Implementation of the bioconversion technologies will involve actions which will impact existing land use patterns. Because of differences in crop type, yield per acre, existing land use conditions and agricultural practices, an aggregated national approach to the assessment of land use is not sufficient. If energy policy regarding bioconversion is to be successful, then it must be sensitive to micro-level information. This paper demonstrates the land use assessment work at the Los Alamos Scientific Laboratory (LASL) in support of the Department of Energy's Technical Assessment of Solar Energy Program, (TASE). Local Biomass potential, existing and use and potential land use impacts from bio-energy implementation for three of the fifteen counties selected for the TASE study will be presented. The methodology creased for the evaluation is useful in determining the biomass potential for any community or county, and in identifying regional differences inherent in the tradeoffs between existing land use and energy production.

28625 (LBL—10058) **California's biomass and its energy potential.** Lucarelli, F.B. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 317p. NTIS, PC A14/MF A01.

Thesis.

The potentials for using California's biomass for energy have been assessed. The study relies on the recent work of Amory Lovins and Lawrence Berkeley Laboratory's (LBL) Distributed Energy System's Project to specify an energy future for Californians. These works identify transportation fuels as the most valuable energy conversion for biomass. Within this context, the extent of five categories of terrestial biomass is estimated, in addition to the environmental impacts and monetary cost of collecting and transporting each biomass category. Estimates of the costs of transforming biomass into different fuels as well as a survey of government's role in a biomass energy program are presented. The major findings are summarized below. (1) California's existing biomass resources are sufficient to provide only 20 percent of its future liquid fuel requirements. (2) Meeting the full transportation demand with biomass derived fuels will require the development of exotic biomass sources such as kelp farms and significant reductions in automobile travel in the State. (3) Under assumptions of moderate increases in gasoline prices and without major new government incentives, the cost of transforming biomass into transport fuels will be competitive with the price of gasoline on a Btu basis by the year 1990. (4) The environmental impacts of collecting most forms of biomass are beneficial and should reduce air pollution from agricultural burning and water pollution from feedlot and dairy farm runoff. Moreover, the collection of logging residues should improve timber stand productivity and the harvest of chaparral should reduce the risk of wildfire in the State. (5) The institutional context for implementing biomass energy projects is complex and fragmented.

28626 (NAL-BIBL—79-30) **Wood as fuel and an alternative energy source. Quick bibliography series, 1968-1978.** Bebee, C.N. (Department of Agriculture, Beltsville, MD (USA)). Jul 1979. 18p. Dept. of Agriculture, National Agriculture Library, Beltsville, MD.

Portions of document are illegible.

Bibliographies in this series are derived from computerized on-line searches of selected data bases. Timeliness of the topic and evidence of extensive interest are selection criteria. Comprehensive subject coverage is not an objective; however, the citations provide a substantial recent resource for investigation of the subject. Each bibliography is updated or dropped after six months.

28627 (NP—24437) **Cogeneration of ethanol from I.C. engine power plants.** Noon, R. (Kansas Energy Office, Topeka (USA)). 1980. 9p. NTIS, PC A02/MF A01.

I.C. engine power plants have significant and suitable waste heat for the production of ethanol. Such power plants are often located in conjunction with cattle and grain producing areas, two of the important ingredients for ethanol production. Cogeneration of ethanol from I.C. engines will afford significant production of ethanol without requiring more fuel than is currently used. A one megawatt peak electrical output rated I.C. engine could produce 250,000 gallons of anhydrous ethanol per year.

28628 (NYSERDA—79-4) **Potential of industrial scale wood combustion in St. Lawrence County.** Lin, F.B.; Ackermann, N.L.; Kear, E.B. Jr. (Clarkson Coll. of Tech., Potsdam, NY (USA)). Oct 1979. 164p. New York State Energy Research and Development Authority, Albany, NY 12223.

The primary objectives of this study are to assess the potential scale of the industrial use of wood as a source of fuel in St. Lawrence County and to determine the feasibility of converting Clarkson College's oil and gas fired heating plant located on its downtown campus at Potsdam into a wood fired plant. The study is also intended to promote the understanding of using wood as a fuel for industrial and institutional applications, and to provide basic information and methods for evaluating specific applications of wood energy. To achieve the objectives, information regarding wood as a fuel and existing technology of wood combustion for industrial-scale applications was first synthesized through a literature review. Methods of economic analysis were then described and a discussion of the economics of wood combustion for steam production and cogeneration was presented. The assessment of the potential scale of wood energy utilization in St. Lawrence County incorporated data compiled by the USDA Forest Service. These data were complemented with information obtained from interview and questionnaire surveys of forest land owners and potential users and suppliers of wood fuel. The feasibility study on the conversion of Clarkson College's downtown heating plant relied on information provided by the College's Director of Physical Plant and a consulting firm.

28629 (NYSERDA—80-2) **Energy from biomass: the simplex process for the gasification of coal and forest pulp.** Arbo, J.C. (Dynecology, Inc., Harrison, NY (USA)). Apr 1980. 96p. New York State Energy Research and Development Authority, Rockefeller Plaza, Albany.

The primary objective for this effort was to investigate the adaptation of the developing Simplex process to the gasification of wood waste and forest pulp. Several specific objectives had to be met to achieve this overall objective: wood supply and wood comminution requirements had to be determined, a briquette formulation procedure has to be developed and tested, and sample briquettes had to be successfully gasified in the small scale Columbia University gasification facility. The study was successful in developing an acceptable sylvan-simplex briquette using a low energy wood comminution technique and commercial briquette manufacturing process. The briquettes exhibited satisfactory performance in the Simplex prototype gasifier at Columbia University and the conclusion follows that the Simplex process has been successfully adapted to forest pulp and wood waste feedstocks. Further development efforts for

both the Simplex and Sylvan-Simplex options should be directed at pilot scale testing in a 10 to 20 ton per day gasifier. This magnitude of scale-up is now appropriate as a further step toward eventual commercialization of this renewable resource fueled technology.

28630 (SERI/TP—621-659) **Biotechnology for a renewable resources chemicals and fuels industry, biochemical engineering R and D.** Villet, R.H. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1980. Contract AC02-77CH00178. 8p. (CONF-800802—4). NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

To establish an effective biotechnology of biomass processing for the production of fuels and chemicals, an integration of research in biochemical engineering, microbial genetics, and biochemistry is required. Reduction of the costs of producing chemicals and fuels from renewable resources will hinge on extensive research in biochemical engineering.

28631 (UCRL—84411) **Solar gasification of charcoal, wood and paper.** Taylor, R.W.; Berjoan, R.; Coutures, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1980. Contract W-7405-ENG-48. 15p. (CONF-800481—1). NTIS, PC A02/MF A01.

From User's Association annual meeting; Las Cruces, NM, USA (15 Apr 1980).

Charcoal, wood and paper have been gasified in a 2 kW solar furnace by injecting water directly on the hot fuel. In the case of charcoal, approximately 30% of the incident solar energy was stored as chemical energy and 55% of the injected water was consumed. Wood and paper gasification can be explained by conventional pyrolysis followed by the gasification of the charcoal formed.

28632 (UCRL-Trans—1593) **Conversion of difficulty-hydrolyzed wood polysaccharides into a readily-hydrolyzed state by the action of hydrogen chloride under pressure. Report 3.** Sharkov, V.I.; Leanova, V.P.; Tsvetkova, L.Ya.; Palova, S.I.; Vasileva, L.P. Mar 1980. Translated from Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidroliza Rastilel'nykh Materialov. Sbornik Trudov, Leningrad, USSR, 1971, Volume 21 pp 65-74. 21p. NTIS, PC A02/MF A01.

Results are reported on investigations of the process of conversion of difficulty hydrolyzed polysaccharides of bone dry and moist wood into a readily hydrolyzed state by treatment with gazeous HCl under pressure, at various temperatures and with different schedules of HCl supply. On base of investigations achieved treatment schedules were developed for scobs treatment by gaseous HCl under pressure ensuring a 90 to 95% output of readily hydrolyzed polysaccharides (as based on their total content).

28633 Anaerobic digestion for methane production - a status report. Klass, D.L. Chicago, IL; Institute of Gas Technology (1980). 30p. (CONF-800482—1).

From Bio-energy world congress and exposition; Atlanta, GA, USA (21 Apr 1980).

Basic research has provided a better understanding of the mechanism of biological gasification, but improvements in digestion efficiencies in terms of methane yield and volatile solids reduction have been slow to evolve from this knowlege. The plateau of about 50% volatile solids destruction efficiencies and 50 to 60% equivalent feed energy recoveries as methane in the product gas seems to be holding. Configurations that have shown advantages over standard high-rate digestion are two-phase, fixed-film, and plug-flow digestion. Considerable laboratory work is in progress to evaluate feedstock suitability and pre- and post-digestion treatments to improve biodegradability. Innovative designs in which thermochemical and biological gasification are combined and in which anaerobic digestion is used to generate in-plant fuel from fermentation alcohol residuals are under development. Demonstration projects are in progress with waste feeds, but none has yet been started with biomass. The only commercial large-scale digestion plant for methane production in the USA uses cattle manure feedstock; it has been shut down for modification because of front-end difficulties. However, commercial methane-from-landfill systems to produce medium- and high-Btu gas are now well established.

28634 Automotive fuels from cellulose materials. Higginson, B.; Thornton, R.H. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1980). 28p. (NZERDC—49).

The results of this investigation showed that it was feasible to link the alcohol fermentation and anaerobic digestion processes into a system for the production of both alcohol and methane from organic substrates. The rate of ethanol production has been determined with respect to cell concentration and the prerequisite of both a high cell concentration and yeast recycling has been shown. Ethanol fermentation under reduced pressure has been shown to be feasible and to give higher ethanol productivities. Although optimization of fermentation has been attempted in this report, with due regard to energy conservation, for industrial application the cost of sugar will be the overriding factor. Cysewski and Wilke (7) pointed out that the cost of sugar overwhelms all other costs in the production of ethanol by fermetation: up to 70 to 80% of the total cost of the ethanol. Results showed that the resultant fermentation spent wash and extracted crop residues could be anaerobically digested to produce methane (and carbon dioxide). A hydraulic retention time of 10 days or longer was needed for effective digestion in which a reduction of chemical oxygen demand (COD) of up to 85% was achieved. Results indicated that further reduction in retention time may be possible if the microbial biomass could be either retained on support media, or recycled more effectively. A gas production rate of 4270 liters gas/m^3 culture/day at 11.6 day retention time was obtained with the anaerobic contact digester using fodder beet spent wash. Using the same substrate, results over short periods with the anaerobic filter system could produce up to 4.8 liters gas/litre culture/day. The high methane composition of this gas (75 to 80%) make this an attractive proposition.

28635 Energy from vegetation: legal issues in biomass energy conversion. Schwab, C. (Solar Energy Research Inst., Golden, CO). *Sol. Law Rep.;* **1**: No. 4, 784-810(Nov 1979).

The major legal and institutional issues to be considered as biomass energy technologies are developed and discussed in terms of the phases in the production of energy from biomass: collection and production, conversion to direct energy souces, and products and delivery systems. Attention is focused on forestry and agricultural residues and wastes and on terrestrial fuel farms. (MHR)

28636 Rediscovery of wood as a fuel. Shirley, A.R. pp 141-143 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

The energy potential of unmerchantable wood and wood wastes in the southwest is discussed. (MHR)

28637 Energy from biomass wastes. Lohuis, D.J. pp 150-155 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

The amount of biomass wastes which are already collected, or are readily collectible, are summarized. The characteristics of crop wastes, animal manures, municipal solid wastes and forestry residues are discussed, as they relate to a refuse derived fuel which can be co-combusted with coal, or otherwise use as a fuel, are reviewed. Advanced therma processes including pyrolysis and gasification, are summarized as they relate to preffered means of preparing wood wastes for such treatment.

28638 Legal and institutional aspects of selected biomass applications. Odland, R. (Solar Energy Research Inst., Golden, CO); Schwab, C. pp 156-160 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

Biomass energy systems, although differing substantially as to specific processes and products, can be divided into three stages for the purposes of legal and institutional analysis. These are (1) collection and/or production of biomass material, (2) conversion to a direct source of energy, and (3) sale and distribution of the direct energy source. The legal and institutonal aspects of these three stages will be examined by using two biomass energy technologies. Municipal solid wastes present an application that is currently in use in a number of communities. Tree farms, on the other hand, are a proposed application. These two technologies were chosen because they present a broad spectrum of legal and istitutional issues.

28639 Uses of duckweed. Hillman, W.S.; Culley, D.D. Jr. (Brookhaven National Lab., Upton, NY). *Am. Sci.;* **66**: No. 4, 442-451(Jul 1978).

Among the various approaches to improving present technologies for waste-water treatment, several involve the use of plants, which can remove pollutants and provide materials useful as animal feeds or energy sources. Various aquatic plants are being proposed in such approaches, and the duckweeds in particular, an essentially unique group of higher aquatic plants, might be especially advantageous in such systems. Although this article focuses on only this one group of plants, it can nevertheless provide an introduction to issues that are both scientifically challenging and existentially inescapable.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 29214, 29404

28640 (DSE—4042-T16) **Electrochemical photovoltaic cells CdSe thin film electrodes. Quarterly progress report No. 1, June-August 1979.** Russak, M.A.; Creter, C. (Grumman Aerospace Corp.,

Bethpage, NY (USA). Research Dept.). Sep 1979. Contract EG-77-C-01-4042. 34p. NTIS, PC A03/MF A01.

The overall objective of this program is to obtain AM1 efficiencies in the range of 10% with electrochemical cells utilizing thin film electrodes. The system currently being investigated is the CdSe/aqueous sulfide-polysulfide system. This report presents the results to date of the initial CdSe deposition parameter study. The key finding has been that the ratio of Se and Cd in the as deposited film has marked effect on the film's chemical, microstructural, optical, and electrical properties as well as I-V performance. In addition, it has been found that electrolyte concentration and compostion can have a strong effect on the I-V performance of a given electrode.

28641 Energy storage in organic photoisomers. Jones, G. II; Chiang, S.H.; Xuan, P.T. (Boston Univ., MA). *J. Photochem.;* **10**: 1-18(1979).

Criteria for the successful photochemical storage of solar energy as latent heat in organic materials are outlined. Photoisomerization reactions which have some potential for storage of photon energy in kinetically stable products are surveyed. Emphasis is placed on well-known internal cyclo-additions which display thermal reversibility, large storage capacities and high chemical and quantum efficiencies. Chemicals available on an industrial scale, which are known to undergo valence isomerization, are identified. Attempts to drive these reactions via exciplexes (complexes involving strong electron donor or electron acceptor sensitizers) are described. The sensitized isomerization of dimethylnorbornadiene-2,3-dicarboxylate (7) and a model compound, hexamethyldewarbenzene, are identified as bona fide exciplex isomerizations. Triplet sensitizers have been employed in the sensitizaion of 7 to visible light (to 500 nm). The potential importance of endothermic energy transfer in tripletsensitization (the upconversion of very low energy triplets) is discussed. The review includes developments by several research groups in the spectral sensitization of isomerizable substrates, the use of heterogeneous photosensitizers, and photocalorimetric techniques. 69 references.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 28583, 28656, 28657, 28734

28642 (CONF-800340—, pp 7.1-7.2) **Photovoltaic/thermal hybrid projects.** Kush, E.A. (Brookhaven National Lab., Upton, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Systems which utilize a combination of photovoltaic and thermal collection in the same solar collectors (PV/T Systems) can have advantages over PV or thermal only systems in that the cost effectiveness of the collectors and their support structure may be improved, active cooling may allow the cells to run at lower temperatures-hence higher conversion efficiency, and space limitations on side by side collectors can be avoided. Evaluation of such systems requires formulation and assessment of collector concepts, power conditioning, storage, and control strategies, and their interactions when combined into a total system. Three projects to accomplish this are currently in progress. Two of them, at MIT/Lincoln Laboratory (MIT/LL) and Brown University address systems with flat plate PV/T collectors and vapor compression heat pump driven by the photovoltaic electric output. The third, at Arizona State University, is studying PV/T concentrating collectors and their potential applications, particularly to solar driven absorption chillers. Progress is reported.

28643 (CONF-800340—, pp 7.3-7.5) **Experimental and analytical system studies on a combined thermal-photovoltaic residential solar system.** Wood, B.D.; Evans, D.L.; McNeill, B.W. (Arizona State Univ., Tempe). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this study is to make combined photovoltaic/thermal (PV/T) solar cooling systems commercially viable by designing and carrying out integrated analytical and experimental systems studies to identify and evaluate overall system and component design criteria. Particular emphasis is placed on concentrator PV/T collectors and absorption cooling. Specifically, the contract is to establish a residential sized concentrator PV/T collector solar cooling test facility for: steady and dynamic system performance testing, in situ component testing, simultaneous model and experiment validation, optimization of control strategies to maximize system performance, minimization of thermal and electrical parasitic losses, and determination of an optimum split between electrical and thermal conversion from the collector array for various solar cooling systems and solar/meteorological regions. Status is described.

28644 (CONF-800340—, pp 7.6-7.8) **Combined solar thermal-photovoltaic systems demonstration: Phase I.** Loferski, J.J. (Brown Univ., Providence, RI). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the first phase of this contract is to produce a conceptual design of a combined photovoltaic/thermal (PV/T) solar energy system for a small single-family residence. Except for the combined PV/T panels themselves, the design should utilize off-the-shelf components, since the whole system is intended for commercialization when the price of photovoltaic cells drops to the levels envisioned by the DOE PV goals for the mid-1980's. The PV/T panels will use air as the heat transfer fluid. The electricity produced by the photovoltaic cells will be interfaced with the electrical utility via a synchronous inverter. This electrical energy will be used mainly for space conditioning; most of it will be used to run a conventional air-to-air heat pump. However, a portion will supply the standard electrical needs of the building. Because PV/T collectors are not commercially available as yet, a principal objective of this program is the design and modelling of optimized PV/T collectors followed by the construction and testing of a few prototypes. The thermal energy provided by the collector will be used to heat the building through a standard solar thermal configuration. The ultimate goals of this project are the construction of the system, its incorporation into a building, monitoring its performance and comparing the performance with predictions based on a model of the system. Project status is outlined.

28645 (DOE/ET/23054—1) **Design of a 100 kW flat panel photovoltaic system at a Washington, DC area waste treatment plant. Final report, October 1, 1978-March 31, 1979.** Belote, J.C.; Borgo, P.A.; Hamilton, M.R.; Yingst, H.A.; Young, S.K. (BDM Corp., McLean, VA (USA)). Mar 1980. Contract AC04-78ET23054. 164p. NTIS, PC A08/MF A01.

The design of a 100 kilowatt flat panel photovoltaic (PV) system is presented. The application is industrial; to supply power to an inductive motor load at a Washington, DC area sewage treatment plant. The sewage treatment plant operation and electrical load characteristics are briefly described. The cells and modules produced by two manufactures are discussed with respect to similarities/differences in performance and fabrication. A design description of the resulting PV arrays using each module is presented. The system elements common to either array are discussed. They include: (1) a power conditioning system consisting of a line-commutated, line feeding inverter with solid state controls, (2) isolation transformers, (3) an instrumentation and control system, and (4) a power distribution system. The inverter is operated in a maximum power tracking mode that automatically maximizes array output power for a given set of operating conditions. Results of a performance analysis using the SOLCEL PV system simulation model are presented in the form of annual power utilization, total load satisfaction, annual energy flow, and 20 year life-cycle levelized busbar energy costs. A discussion of key technical, legal, institutional, and environmental issues for this specific application concludes the report.

28646 (DOE/ET/23058—1) **150 kilowatt photovoltaic flat panel facility for a shopping center application in Lovington, New Mexico. Final technical report, 1 November 1978-31 March 1979.** James, M.R. (Lea County Electric Cooperative, Inc., Lovington, NM (USA)). May 1980. Contract AC04-78ET23058. 104p. NTIS, PC A06/MF A01.

The photovoltaic (PV) facility will be located in Lovington (Lea County), New Mexico, in the southeastern part of the state. Although the PV facility is tied directly to the LCEC grid, the system will supply power to the Lovington shopping center, which consists of nine stores with a total floor area in excess of 40,000 square feet. The PV system designed during Phase I uses Solar Power Corporation (SPC) Model G-361 modules arranged in subarrays approximately 56 feet long. Each subarray is divided structurally into two panels, hinged for tilt adjustment. The module utilizes round, 4-inch diameter single-crystal silicon p-n junction PV cells bonded to a 1/8-inch tempered glass cover, which serves as a structural element. A special corrosion resistant metallization is used for the electrodes. Each module produces, nominally, 15.1 volts, 2.0 amps at peak power point, 46°C cell temperature, and 100 MW per sq cm sunlight intensity. The detailed design, specifications, and systems analysis are presented. An environmental assessment is included. (WHK)

28647 (DOE/TIC—11190) **Satellite Power Systems (SPS) cost review.** Crowley, J.H.; Ziegler, E.J. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 89p. NTIS, PC A05/MF A01.

A study to determine estimated costs for three selected SPS designs is presented. One SPS concept uses silicon solar cells with a concentration ratio of one; one concept uses gallium arsenide solar cells with a concentration ratio of two; and the third (reference) design incorporates features of the first two. Selected system defini-

tion assumptions and cost estimating relationships for each of the three SPS concept designs were independently reviewed. The systems within the SPS designs chosen include: rectenna construction, graphite fiber reinforced thermoplastic structures, solar cells, satellite electrical slip rings, satellite electrical systems, and ground rectenna electrical systems. Procedures and results are detailed. (WHK)

28648 (SAND—80-0749C) **Simple economic evaluation and applications experiments for photovoltaic systems for remote sites.** Rios, M. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01.

A simple evaluation of the cost effectiveness of photovoltaic systems is presented. The evaluation is based on a calculation of breakeven costs of photovoltaics (PV) arrays with the levelized costs of two alternative energy sources (1) extension of the utility grid and (2) diesel generators. A selected number of PV applications experiments that are in progress in remote areas of the US are summarized. These applications experiments range from a 23 watt insect survey trap to a 100 kW PV system for a national park complex. It is concluded that PV systems for remote areas are now cost effective in remote small applications with commercially available technology and will be cost competitive for intermediate scale systems (~ 10 kW) in the 1980s if the DOE 1986 Commercial Readiness Goals are achieved.

28649 **100-kW peak photovoltaic power system.** Lyon, E.F. (Lincoln Lab., Lexington, MA). *Trans. Am. Nucl. Soc.;* **33**: 20-21(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 28583, 28807, 29160

28650 (ANL—80-34) **Biaxial creep-fatigue behavior of materials for solar thermal systems.** Majumdar, S. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01.

Biaxial creep-fatigue data for Incoloy 800 and Type 316H stainless steel at elevated temperatures are presented. Tubular specimens were subjected to constant internal pressure and strain-controlled axial cycling with and without hold times in tension as well as in compression. The results show that the internal pressure affects diametral ratchetting and axial stress range significantly. However, the effect of a relatively small and steady hoop stress on the cyclic life of the materials is minimal. A 1-min compressive hold per cycle does not seriously reduce the fatigue life of either material; a tensile hold of equal duration causes a significant reduction in life for Type 316H stainless steel, but none for Incoloy 800. Fracture surfaces of specimens made of both materials were studied by scanning electron microscopy to determine the reason for the difference in behavior.

28651 (DOE/JPL—1060-35) **Cost and price estimate of Brayton and Stirling engines in selected production volumes.** Fortgang, H.R.; Mayers, H.F. (Jet Propulsion Lab., Pasadena, CA (USA)). 31 May 1980. Contract AI01-79ET20397. 15p. NTIS, PC A02/MF A01.

This report details the methods used to determine the production costs and required selling price of Brayton and Stirling engines modified for use in solar power conversion units. The Brayton engine, designed by Garrett AiResearch Manufacturing Company, was upgraded to a 20 kW design. The Stirling 30 kW engine was designed by United Stirling of Sweden for non-solar applications. Each engine part, component and assembly was examined and evaluated to determine the costs of its material and the method of manufacture based on specific annual production volumes. Cost estimates are presented for both the Stirling and Brayton engines in annual production volumes of 1000, 25,000, 100,000, and 400,000. At annual production volumes above 50,000 units, the costs of both engines are similar, although the Stirling engine costs are somewhat lower. It was concluded that modifications to both the Brayton and Stirling engine designs could reduce the estimated costs.

28652 (DOE/SF/00012—T1) **Worker health and safety in solar thermal power systems. IV. Routine failure hazards.** Ullman, A.Z.; Sokolow, B.B.; Hill, J.; Meunier, G.; Busick, H. III. (California Univ., Los Angeles (USA)). Sep 1979. Contract AM03-76SF00012. 110p. NTIS, PC A06/MF A01.

Routine failure events in selected solar thermal power system designs are examined, and their rates of occurrence estimated. The results are used to compare and rank the systems considered. Modules of 1 to 100 MWe are developed based on reference or other near-term designs. Technologies used include parabolic trough, parabolic dish, and central tower focusing; central and distributed power generation; and proximate and independent siting of power modules. Component counts and failure rates estimated include heat transfer system leaks, sensor failures, and mechanical and electrical component failures, such as pumps, motors, and wire and cable. Depending on the technology chosen, leak rates can approach 1000 per year per 100 MWe system capacity, while component failure rates can be several times that level. Within categories of failures, the various technologies can have rates differing by a factor of 1000 or more. A uniform weighting for the consequences of the various failure types is proposed. Under this weighting, central tower systems are most favored, followed by parabolic trough, parabolic dishes with dispersed power generation, and parabolic dishes with central power generation. This weighting does not account for possible variations in the technologies. A sensitivity analysis is used to bound the relative hazards of the various failure events required to invert one or more of the system rankings.

28653 (SERI/TP—731-706) **Decision analysis: a tool to guide the R and D selection of alternative energy sources.** Kriz, T. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 8p. (CONF-800567—1). NTIS, PC A02/MF A01.

From International symposia alternative energy sources and technology; Montreal, Canada (28 May 1980).

The array of alternative energy sources which are vying for the federal government's R and D dollar is formidable when compared to the politically acceptable amount which can be used to fund the research. To guide how these funds should be dispersed, a rational, defensible procedure is needed which can repeatedly be applied as new technologies and new information become available. The procedure advanced in this paper is a decision analysis technique known as multi attribute decision analysis (MADA) and its use is illustrated in an evaluation and ranking of solar thermal electric power generating systems. Since the ultimate purchase decision is made in the market place, the preferences of potential users have been sampled and brought to bear on the ranking. The focus of this description is on the formulation of the problem structure and the decision model, the treatment of uncertainty, and how the results relate to the questions asked by and of the Department of Energy, which funded the study. A final note proposes how decision analysis can be used to address the broader questions of choice among competing technologies with cautions concerning misuse of the procedure.

28654 **R and D overview emphasizing solar thermal power systems.** Butler, B.L. (Solar Energy Research Inst., Golden, CO). *SAMPE Q.;* **11**: No. 3, 14-15(Apr 1980).

A brief discussion is presented about the major thrusts of the DOE/SERI materials program. The more significant problem areas are identified as are the planned elements of a materials program which address those problems. Relevant research areas are outlined.

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 28811

28655 **Solar One: a 10-MW solar thermal central receiver pilot plant.** Schweinberg, R.N. (Dept. of Energy, El Monte, CA); Reeves, J.N. *Trans. Am. Nucl. Soc.;* **33**: 18-19(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

TOTAL ENERGY AND HYBRID SYSTEMS

28656 (DOE/CS/04270—1) **Concentrating photovoltaics for the Tropics. Final Report, June 1, 1978-February 28, 1979.** (Puerto Rico Energy Office, Santurce). 30 Jun 1979. Contract AC04-78ET20561. 284p. NTIS, PC A13/MF A01.

The design and specification of a photovoltaic concentrator total energy system are presented. The design will provide nearly half the electrical energy needs and most of the thermal energy needs (absorption chillers) of the Center for Energy and Environment Research, University of Puerto Rico, and the hot water needs of the Oncologic Hospital and Children's Hospital, Puerto Rico Medical Center. The system will utilize 34,190 sq ft of 40X slat type concentrators with secondary CPC concentrators to provide 162 kWe. The combined photovoltaic/thermal collector system utilizes a 20,000 gal steel thermal storage tank, and two absorption refrigeration units which will produce a total of 149 tons of cooling. Detailed drawings and system fabrication and installation plans are included. Insolation data for the San Juan, Puerto Rico site are presented, and calculated system performance based on this data is presented. (WHK)

28657 (DOE/CS/24278—1(Vol.1)) **64 kW concentrator Photovoltaics Application Test Center. Volume. Final report.** Jardine, D.M.; Jones, D.W. (Kaman Sciences Corp., Colorado Springs, CO (USA)). Jun 1980. Contract AC04-78ET11025. [illegible] NTIS, PC A06/MF A01.

Kaman Sciences Corporation has designed a 64 kW Concentrating Photovoltaic Applications Test Center (APTEC). The APTEC employs a combined concentrating photovoltaic array in a total energy system application for load sharing the electric and thermal demands of a large computer center with the interfaced electric and natural gas utility. The photovoltaic array is composed of two-axis tracking heliostats of Fresnel lens concentrating, silicon solar cell modules. The modules are cooled with a fluid which transfers heat to a ground coupled heat sink/storage unit for subsequent use in meeting the computer center's thermal load demand. The combined photovoltaic power system shares basic components - a power conditioning unit, batteries and thermal conditioning equipment - with the electric and natural gas utility service, improving the computer center's operating availability time and displacing a portion of the fossil fuel required to power the computer center with solar energy. The detailed system design is reported.

28658 **Solar Total-Energy Project, Shenandoah, Georgia.** Hensley, W.R. (Georgia Power Co., Atlanta); Poche, J.; Hunke, R.; Ney, E.J. *Trans. Am. Nucl. Soc.*; 33: 19-20(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 29175

28659 (ANL/MSD—80-3) **Corrosion evaluation of materials from the second deployment of the Gulf of Mexico Experiment.** Zeman, G.J. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 44p. NTIS, PC A03/MF A01.

The corrosion behavior and nature of films formed on 5052 aluminum, CA706 copper-nickel alloy, AL-6X stainless alloy, and grade 2 titanium in seawater during the second deployment of the Gulf of Mexico Experiment (GOME II) were evaluated by optical and scanning-electron microscopy as well as gravimetric measurements. The thickness of the corrosion-product and biofouling film on the copper-nickel alloy increased linearly with time over the 99-day duration of the experiment, whereas the film thickness on aluminum was independent of exposure time. The uniform corrosion of aluminum and the copper-nickel alloy, based upon defilmed metal loss from preweighed ring specimens, was ~ 0.3 and 0.7 mils, respectively, for the 55-day exposure period. The thin films formed on stainless alloy and titanium were composed primarily of organic residues. The corrosion resistance of titanium and stainless alloy was excellent under the conditions in this experiment, although some evidence for pitting attack was found for the latter material. This study is directed toward the evaluation of candidate materials for OTEC heat exchangers.

28660 (ANL/OTEC-TM—2) **Ocean Thermal Energy Conversion Program Management Plan.** Combs, R.E. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 47p. NTIS, PC A03/MF A01.

The Office of the Associate Laboratory Director for Energy and Environmental Technology has established the OTEC Program Management Office to be responsible for the ANL-assigned tasks of the OTEC Program under DOE's Chicago Operations and Regional Office (DOE/CORO). The ANL OTEC Program Management Plan is essentially a management-by-objective plan. The principal objective of the program is to provide lead technical support to CORO in its capacity as manager of the DOE power-system program. The Argonne OTEC Program is divided into three components: the first deals with development of heat exchangers and other components of OTEC power systems, the second with development of biofouling counter-measures and corrosion-resistant materials for these components in seawater service, and the third with environmental and climatic impacts of OTEC power-system operation. The essential points of the Management Plan are summarized, and the OTEC Program is described. The organization of the OTEC Program at ANL is described including the functions, responsibilities, and authorities of the organizational groupings. The system and policies necessary for the support and control functions within the organization are discussed. These functions cross organizational lines, in that they are common to all of the organization groups. Also included are requirements for internal and external reports.

28661 (DOE/NOAA/OTEC—2(AppendixC)) **Assessment of the state-of-the-art technology related to SKEET (station keeping subsystem engineering evaluation tool). Final report.** (Hoffman Maritime Consultants, Inc., Glen Head, NY (USA)). Aug 1979. Contract EG-77-A-29-1078. 143p. NTIS, PC A07/MF A01.

A bibliography of references related to analysis or evaluation of station keeping systems or moorings for offshore platforms is presented. With each reference is included an abstract, comments on the paper, and a short description of the applicability of the paper to SKEET. (WHK)

28662 (DOE/NOAA/OTEC—3) **Evaluation of physical characteristics and phenomena, sensitivity and interaction effects, performance criteria and output requirements for a station keeping subsystem engineering evaluation tool (SKEET).** (Hoffman Maritime Consultants, Inc., Glen Head, NY (USA)). Dec 1979. Contract EG-77-A-29-1078. 47p. NTIS, PC A03/MF A01.

The fundamental purpose for SKEET is to provide a means of simulating and evaluating OTEC platform SKSS performance. This evaluation capability may be employed in the process of a design review, comparison of alternative concepts, operational planning, establishing risk and reliability criteria and a host of other applications. However, the central requirement is that SKEET have the capability to predict the excursions on motions of the platform and loads on the SKSS as a result of environmental effects under a range of operational conditions. The principal elements which should be represented by the SKEET model include: environment (wind, current, waves); vessel/CWP configuration; mooring system (including anchor/soil and electrical riser cable interactions); and dynamic positioning system effects. Findings are summarized of the following two tasks that have been undertaken to formulate a definition of the requirements of SKEET: Task III - identify and classify the physical characteristics and phenomena and evaluate interaction effects; and Task IV - establish mooring performance criteria. The objective of Task III was to define the range of physical parameters that must be incorporated into SKEET and to make an assessment of the most appropriate manner in which to incorporate each of those parameters. The objective of Task IV was to define the required outputs from SKEET. (WHK)

28663 (DOE/NOAA/OTEC—4) **Definition of the requirements of a station keeping subsystem (SKSS) engineering evaluation tool (SKEET). Final report.** (Hoffman Maritime Consultants, Inc., Glen Head, NY (USA)). Dec 1979. Contract EG-77-A-29-1078. 74p. NTIS, PC A04/MF A01.

A study of the requirements of an OTEC Station Keeping Subsystem (SKSS) Engineering Evaluation TOOL (SKEET) has been completed by Hoffman Maritime Consultants Inc. SKEET is intended to provide a basis for quantitative comparison and assessment of candidate SKSS performance based on realistic predictions of expected loads, motions and displacements obtained by modeling all significant environmental and operational factors. The objectives of the study are: to define the required elements of a SKEET, and to assess the state of the art of technology related to SKEET. The results provide a technical basis for decisions regarding the planning, acquisition and implementation of a SKEET. It is noted that selection of specific analytical methods to be incorporated in SKEET is beyond the scope of the present study. The requirements for formulation of a SKEET, based on supporting documentation provided in separate volumes, are summarized. The results of the study have shown that: existing technology and methods of analysis are adequate to fulfill the basic requirements of SKEET, except that further validation is required for methods of predicting second order wave drift forces for cases other than ship in beam seas. Therefore, it is concluded that: development of a SKEET is essentially a process of selection, adaptation, integration and validation; and that a basic SKEET capability could be achieved within a one year period.

28664 (DOE/NOAA/OTEC—5) **Preliminary designs for ocean thermal energy conversion (OTEC) stationkeeping subsystems (SKSS). Task I. Design requirements. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 1 Jun 1979. Contract EG-77-A-29-1078. 156p. (LMSC-D—673832). NTIS, PC A07/MF A01.

The results of Task I, Design Requirements, are presented. Environmental conditions for the Punta Tuna, Puerto Rico site are reviewed and synthesized to provide definition of current, wind and wave severity, direction, and occurrence for service, operational, and extreme sea states. SKSS performance requirements, including design life and watch circle, are followed by interface considerations particularly for the electrical transmission riser cable, and design criteria including safety and load factors. The SKSS concepts will be analyzed to evaluate performance, reliability, and cost. Performance analysis conducted included catenary anchor leg static calculations to size components, as well as drag due to environmental loads in the operational and extreme sea states for both ship and spar platforms. Dynamic analyses and trade studies to be conducted in Task II are presented. A reliability and risk assessment analysis of the three basic SKSS types - single-, multiple-, and tension-anchor-leg moors - was completed, indicating that the multiple-anchor-leg/multiple-point rotary or turret moor has the lowest risk-criticality for the ship, while that for the spar is the multiple-anchor-leg/multiple-point moor. The catenary single-anchor-leg/single-point moor has insufficient reliability for both platforms. The life cycle cost analysis methodology, including work breakdown structure, cost estimating, and cost minimization define the approach to costing to be followed throughout the study. The results of these design trades and analyses will first be applied to concept ranking required for recommendation of a SKSS concept for each platform.

28665 (DOE/NOAA/OTEC—6) **Preliminary designs for ocean thermal energy conversion (OTEC) stationkeeping subsystems (SKSS). Task II. Conceptual design. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 27 Jul 1979. Contract EG-77-A-29-1078. 222p. (LMSC-D—676379). NTIS, PC A10/MF A01.

The study is presented in five sections: design loads, conceptual designs, trade studies, cost analysis and concept evaluation and ranking. Extensive appendixes provide back up calculations and data to support the results. Environmental forces and yaw moments acting on the barge and spar in the various design sea states are presented including wave, wind and current effects. A parametric analysis illustrates the impact on holding power requirement of varying the return periods for operational and extreme sea state. The conceptual designs are presented for the barge followed by those for the spar, including configuration definition, performance characteristics, interfaces, areas for development, and deployment scenarios for selected concepts. The concept definition is followed by a set of trade studies that were performed to evaluate candidate anchor types and anchor leg materials. Parametric variations in anchor leg characteristics, wire-rope-to-chain length ratio for example, illustrate the influence of the significant design parameters on performance. An extensive cost analysis of the candidate SKSS concepts is presented, including cost estimates, life cycle cost scenarios leading to expected value of life cycle cost, and cost equivalence of operational failures. An evaluation of the eight SKSS concepts is presented, including assessment of performance and rankings based on risk versus cost and technology development. The appendixes include a report on the Electrical Transmission System interface, wave drift force, typical cost disbursement schedule and computer program listing, the IMODCO conceptual design report, and static configuration results.

28666 (DOE/NOAA/OTEC—7) **Preliminary design report for OTEC stationkeeping subsystems (SKSS).** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 12 Dec 1979. Contract EG-77-A-29-1078. 336p. (LMSC-D—678771). NTIS, PC A15/MF A01.

Lockheed Ocean Systems with IMODCO prepared these preliminary designs for OTEC Stationkeeping Subsystems (SKSS) under contract to NOAA in support of the Department of Energy OTEC program. The results of Tasks III, V, and VI are presented in this design report. The report consists of five sections: introduction, preliminary designs for the multiple anchor leg (MAL) and tension anchor leg (TAL), costs and schedule, and conclusions. Extensive appendixes provide detailed descriptions of design methodology and include backup calculations and data to support the results presented. The objective of this effort is to complete the preliminary designs for the barge-MAL and Spar-TAL SKSS. A set of drawings is provided for each which show arrangements, configuration, component details, engineering description, and deployment plan. Loads analysis, performance assessment, and sensitivity to requirements are presented, together with the methodology employed to analyze the systems and to derive the results presented. Life cycle costs and schedule are prepared and compared on a common basis. Finally, recommendations for the Commercial Plant SKSS are presented for both platform types.

28667 (DOE/NOAA/OTEC—10) **At-sea test system point design for a one-third scale cold water pipe.** Sutherland, W.H. (ed.). (ORI, Inc., Silver Spring, MD (USA)). Dec 1979. Contract EG-77-A-29-1078. 114p. NTIS, PC A06/MF A01.

One step in the development of the technology for Ocean Thermal Energy Conversion (OTEC) Cold Water Pipes (CWP) is the at-sea testing of a fiberglass reinforced plastic nominal 10-foot diameter pipe. A design procedure and criteria for developing test hardware by scaling down a 30-foot diameter OTEC 10/40 MW Pilot Plant CWP design are presented. An example point design for the pipe, instrumentation to be used during the at-sea tests, and methods for selecting the support platform and mooring are described. The design considered starts with a scale model of a larger prototype, and then is modified to address the problems of fabrication and of survivability and handling during the 1/3rd scale model tests.

28668 (DOE/NOAA/OTEC—12) **OTEC cold water pipe: a survey of available shell analysis computer programs and implications of hydrodynamic loadings.** Pompa, J.A.; Allik, H.; Webman, K.; Spaulding, M. (ORI, Inc., Silver Spring, MD (USA)). Feb 1979. Contract EG-77-A-29-1078. 64p. NTIS, PC A04/MF A01.

The design and analysis of the cold water pipe (CWP) is one of the most important technological problems to be solved in the OTEC ocean engineering program. Analytical computer models have to be developed and verified in order to provide an engineering approach for the OTEC CWP with regards to environmental factors such as waves, currents, platform motions, etc., and for various structural configurations and materials such as rigid wall CWP, compliant CWP, stockade CWP, etc. To this end, Analysis and Technology, Inc. has performed a review and evaluation of shell structural analysis computer programs applicable to the design of an OTEC CWP. Included in this evaluation are discussions of the hydrodynamic flow field, structure-fluid interaction and the state-of-the-art analytical procedures for analysis of offshore structures. The analytical procedures which must be incorporated into the design of a CWP are described. A brief review of the state-of-the-art for analysis of offshore structures and the need for a shell analysis for the OTEC CWP are included. A survey of available shell computer programs, both special purpose and general purpose, and discussions of the features of these dynamic shell programs and how the hydrodynamic loads are represented within the computer programs are included. The hydrodynamic loads design criteria for the CWP are described. An assessment of the current state of knowledge for hydrodynamic loads is presented. (WHK)

28669 (DOE/NOAA/OTEC—14) **Ocean thermal energy conversion cold water pipe preliminary design project. Final report.** (TRW Systems and Energy Group, Redondo Beach, CA (USA)). 20 Nov 1979. Contract EG-77-A-29-1078. 220p. NTIS, PC A10/MF A01.

As part of a DOE goal to develop one or more OTEC Modular Experiment Plants, TRW performed designs, analyses, and evaluations of cold water pipe (CWP) concepts for NOAA. After reviewing the results of the CWP concept selection phase NOAA/DOE selected three concepts for a baseline design: (1) a FRP CWP of sandwich wall construction suspended from the Applied Physics Laboratory/John Hopkins University (APL/JHU) barge at a site 200 miles east of the coast of Brazil using a horizontal deployment scheme (this is TRW's preferred approach); (2) an elastomer CWP suspended from the APL/JHU barge off the southeast coast of Puerto Rico using either a horizontal or vertical deployment scheme; and (3) a polyethylene CWP (single or multiple pipe) suspended from the Gibbs and Cox spar at the Puerto Rico site using a horizontal deployment scheme. TRW has developed a baseline design for each of these configurations. Detailed designs and analyses for the FRP, polyethylene, and elastomer concepts, respectively, are described. A discussion of fabrication plans and processes, schedules for mobilization of facilities and equipment, installation plans, and cost breakdown are given for each concept. (WHK)

28670 (DOE/NOAA/OTEC—17) **OTEC current study. Final report.** (Naval Facilities Engineering Command, Washington, DC (USA)). Mar 1979. Contract EG-77-A-29-1078. 73p. NTIS, PC A04/MF A01.

Under a contract with the Applied Physics Laboratory of John Hopkins University, the firm Deep Oil Technology, Inc. planned and carried out a verification test on a model OTEC Cold Water Pipe to investigate the potential effect of some environmental forces in a true ocean environment. The dimensions of the model CWP were 5 feet in diameter and 800 feet long; the pipe was made up of 20-foot lengths of 3/16-inch steel pipe with flanges at either end that were bolted together to form the total test length. This model CWP was suspended from the Deep Oil X-1 which was moored in 1000 feet of water about two miles south of Santa Catalina Island in the Pacific Ocean during December 1978. The Ocean Engineering and Construction Project Office of the Chesapeake Division, Naval Facilities Engineering Command was tasked in October 1978 by the National Oceanic and Atmospheric Administration (NOAA) to provide current data in conjunction with this OTEC Cold Water Pipe experiment off the seaward side of Santa Catalina Island. The current meter system comprises eight Aanderaa current meters, 100 feet apart, suspended from a 40 inch diameter subsurface buoy and anchored to the bottom. The Aanderaa, RCM-5 Current Meter is a self-contained instrument for recording speed, direction, and temperature of ocean currents; operation is based upon a rotor-type current velocity sensor, a magnetic compass for direction determination, and a thermistor for temperature sensing. Installation and inspection of the current meters are described, and recorded data are presented and discussed. (WHK)

28671 (DOE/NOAA/OTEC—19) **OTEC cold water pipe hydroelastic response experiment.** Taylor, S.; Shih, B.; Hove, D. (Science Applications, Inc., El Segundo, CA (USA)). Jul 1979. Contract EX-76-C-01-2331;EG-77-A-29-1078. 45p. (SAI—063-80R-047-LA). NTIS, PC A03/MF A01.

OTEC cold water pipes in an ocean current cross-flow will experience time dependent hydrodynamic loads induced by alternate shedding of vortices. For flexible pipes the problem becomes increasingly complex since the hydrodynamics couples with the dynamics of the pipe producing a phenomenon known as vortex strumming. The general approach taken is to first identify the important parameters influencing the motion of typical OTEC cold water pipes in still water. The relevant parameters are identified by first formulating and nondimensionalizing the structural equation of motion that is applicable to all OTEC CWP designs. An order-of-magnitude analysis then yields the parameters which most strongly influence the natural response of any given cold water pipe design. The nondimensional equation also specifies how one must scale the parameters in order to conduct a useful experiment. The natural response of the pipe serves as basis for comparison for the overall

fluid-structural response. Although most of the proposed CWP designs are geometrically similar and all convey an incompressible fluid, the many combinations of materials, wall thickness-to-diameter ratios, and end conditions provide a wide variety of possible dynamic responses. For example, internal pumping is important in some designs but not in others, as is shown. However, through the order-of-magnitude analysis it is realized that most CWP designs fall into one of two distinct classes of problems: one, the pipe offers essentially no resistance to bending (the Bell Aerospace design is a good example), and two the bending restoring force is important. Since attention has been focused to date on the latter class of cold water pipes, the present experimental investigation was directed toward such designs although compliant rubber pipe was also tested. Results are presented and discussed.

28672 (DOE/NOAA/OTEC—20) **Measurement of polyethylene pipe parameters during an ocean deployment. Final report.** Hoppmann, R.F.; Ritchie, P.L. (General Electric Co., Philadelphia, PA (USA). Re-Entry and Environmental Systems Div.). 15 Nov 1978. Contract EG-77-A-29-1078. 71p. NTIS, PC A04/MF A01.

Data were acquired on the behavior of the polyethylene upwelling pipe for the GRI/DOE Marine Biomass Biological Test Farm during several phases of pipe assembly and ocean towing and deployment. The pipe is nominally 28 in O.D., 1400 feet long with wall thicknesses of 0.9 and 1.75 inches. The entire effort was conducted over a period of six weeks and was implemented on a strictly non-interference basis with the main Biomass Program. Three types of data were acquired during shore and ocean based operations conducted in the southern California area during the period from 15 September-27 September 1978. Axial strain data were obtained from two rows of 15 transducers each, separated circumferentially by 90° and distributed along the entire length of the pipe. Photographic data were also acquired from helicopter, boat and shore stationed cameras. The third type of data acquired were lowering line tension measurements made during the second successful deployment operation.

28673 (DOE/NOAA/OTEC—21) **Hydrodynamic design loads for the OTEC cold water pipe.** Hove, D.; Shih, W.; Albano, E. (Science Applications, Inc., El Segundo, CA (USA)). Sep 1978. Contract EG-77-A-29-1078. 143p. (SAI—79-559-LA). NTIS, PC A07/MF A01.

Ocean current and/or plant motion crossflows induce time dependent hydrodynamic loads on the OTEC cold water pipe due to vortex shedding. Design criteria were established for mean and fluctuating loads based on a review of the literature, analysis of test data acquired by SAI under a previous experimental program and an analytical extension of test results to higher Reynolds number. Baseline loads were specified for rigid cylinders in uniform flows. Modifications to the loads by current shear, stratification and cylinder motion, were investigated and final design criteria established. Limited structural response calculations were performed to demonstrate the use of the design criteria and to investigate briefly the possible structural response mode. Comparisons were made with alternate hydrodynamic loads, and recommendations were made for experimental verification.

28674 (DOE/NOAA/OTEC—22) **Model tests of OTEC-1: test of HMB with and without cold water pipes.** Sheldon, L.R.; Barr, R.A.; O'Dea, J.F. (Hydronautics, Inc., Laurel, MD (USA)). Dec 1977. Contract EY-76-C-02-2681;EG-77-A-29-1078. 72p. (COO—2681-2). NTIS, PC A04/MF A01.

In early 1977, ERDA began an extensive study of various factors which could effect the early design and deployment of OTEC-1, a test platform for evaluation of one megawatt (1 MW) OTEC heat exchangers. The platform was to consist of the Hughes Mining Barge (HMB) and a 3000 foot deep cold water pipe (CWP). One of the factors to be considered was the motions of the HMB and the motions, loads and stresses of the CWP. Several theoretical methods, including one developed at HYDRONAUTICS, Incorporated were to be used to predict motions and CWP loads and stresses. There existed, however, no model tests or other validation of these theoretical methods. The lack of any validation of the theoretical methods was of some concern as early studies indicated that high CWP bending stresses, in particular, could represent a significant design problem. In early May 1977, HYDRONAUTICS proposed to carry out model tests of a one-fiftieth scale model of the HMB with several CWP models representing relatively rigid (steel) and flexible (glass reinforced plastic GRP) CWP's. This proposal was accepted by ERDA, and the model tests were carried out during June 1977. Preliminary results were provided to ERDA during June and July 1977. This report describes the work carried out and presents and discusses the results, including a comparison of measured and predicted results.

28675 (DOE/NOAA/OTEC—23) **Seakeeping model tests of a 400 MW OTEC spar platform and cold water pipe.** Kowalyshyn, R.; Barr, R.A. (Hydronautics, Inc., Laurel, MD (USA)). Jan 1979. Contract EY-76-C-02-2681;EG-77-A-29-1078. 58p. (COO—2681-4). NTIS, PC A04/MF A01.

A number of theoretical methods are currently being used to predict seakeeping behavior (behavior in a seaway) of complete OTEC plants including a platform and CWP. Validation of these methods is generally limited, due in part to the limited available test data. To date no at-sea data and only one set of model test data are available for a complete OTEC plant. The primary purpose of the present and previous tests is to provide data for validation. The present tests are for a large (400 MW) spar type platform developed by Lockheed Missiles and Space Company (LMSC). A 1:110 scale model was constructed and used for testing. Tests were carried out for the following configurations: spar alone, spar with CWP free in pitch and roll, and spar with CWP rigidly attached. For all seakeeping tests, wave height and five motions (heave, pitch, roll, surge, sway) of the spar model were measured. Results are presented in the form of response amplitude operators and significant (average of one-third highest) amplitudes for random waves. Test results are also compared with theoretical predictions made for the exact conditions of the test model. (WHK)

28676 (ORO—5440-2) **Construction of and experiments with an osmo-power pilot plant. Final report, 1 October 1977-30 September 1978.** Jellinek, H.H.G.; Masuda, H. (Clarkson Coll. of Tech., Potsdam, NY (USA). Dept. of Chemistry). 20 Feb 1979. Contract AS05-77ET20335. 64p. NTIS, PC A04/MF A01.

Various membranes, including homemade asymmetric cellulose acetate membranes were characterized as to their water flux, salt flux, salt rejection and ultimate osmotic pressure reached for 3.5% w/v NaCl solution/fresh water systems. A small osmotic apparatus, equipped with conductance cells and stirrers has been used for obtaining fluxes and salt-rejection data. An Osmonics membrane (asymmetric cellulose acetate membrane) spiral desalination module was built into an osmo-power pilot plant. However, most of the osmotic pressure was lost. It was concluded that desalination membrane arrangements are not suitable for osmo-power production as all are very tightly wound or have very small tube diameters. The theory for osmo-power production on hydrodynamic ground for ideal membranes (i.e., membranes whose only characteristic is semi-permeability) and real membranes has been developed. An osmo-power pilot plant has been constructed and successfully operated. It consists of a number of subunits having 26 membranes in parallel (total membrane area 0.16 m^2). The fresh water/3.5% w/v NaCl saline solution system produced an osmotic pressure of 290 p.s.i. with Osmonics SEPA PS97 membranes (with dye). The water flow rate was 12g $ft^{-2}s^{-1}$, the salt flux 0.79 x 10^{-8} mole $cm^{-2}s^{-1}$ and the salt rejection 97%. The power output of the pilot plant amounts (with addition of 5 ppM basic dye) to 1.85 watts/m^2 of membrane area. It is shown that the higher power-output of the pilot plant is due to concentration polarization of real membranes which produces an effective osmotic pressure for water permeation several times larger than that of the bulk solution. A cost estimate yields 6.5 cents/kWh.

28677 (SERI/TP—732-600) **Proceedings of the ocean energy information dissemination workshop, December 1979.** Petty, D. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1980. Contract AC02-77CH00178. 22p. NTIS, PC A02/MF A01.

The workshop was held to discuss the status of marketing ocean energy information and to develop an understanding of information needs and how to satisfy them. Presentations were made by the Solar Energy Research Institute (SERI) staff and media consultants about the effective use of audio-visual and print products, the mass media, and audience needs. Industry and government representatives reported on current efforts in each of their communication programs and outlined future plans. Four target audiences (DOE contractors, researchers, influencers, and general public) were discussed with respect to developing priorities for projects to enhance the commercialization of ocean energy technology.

28678 **Flow field near an ocean thermal energy conversion plant.** Sheppard, D.M.; Powell, G.M.; Chou, I.B. (Univ. of Florida, Gainesville). pp 3068-3081 of Fifteenth coastal engineering conference. New York, NY; American Society of Civil Engineers (1977).

From 15. conference on coastal engineering; Honolulu, HI, USA (11 Jul 1976).

The stratified thermocline water mixing downstream from an OTEC plant was studied using a stratified flow facility. Results are presented and discussed. (WHK)

28679 (DOE/NOAA/OTEC—9) **Effects of shear on vortex shedding patterns in high Reynolds number flow: an experimental study.** (ORI, Inc., Silver Spring, MD (USA)). [nd]. Contract EG-77-A-29-1078. 71p. NTIS, PC A04/MF A01.

Vortex shedding has been identified as a potential major source of loading on the Ocean Thermal Energy Conversion (OTEC) Plant Cold Water Pipe (CWP). To gain a better understanding of the vortex shedding phenomena, a series of model tests has been conducted. The results of this investigation are presented.

The effects of current shear on vortex shedding patterns in high Reynolds number (R/sub e/) flow around a circular cylinder used to model the OTEC CWP are addressed. Tests were conducted in a wind tunnel on a 56-inch long, 6-inch diameter circular cylinder for various flow and shear conditions. Measurements were conducted to describe the frequencies of the eddies shed from the cylinder and to investigate the fluctuating surface pressure on the cylinder. From these tests it was determined that shedding for high R/sub e/ sheared flow is characterized by the formation of distinct cells of eddies with constant frequency, that pressure fluctuations on the surface of the cylinder are greater for sheared flow than unsheared flow, and that the mean surface pressures are generally independent of the magnitude of shear.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 28585, 28799

28680 (CONF-800340—, pp 12.11-12.12) **Simulation and design of solar thermal processes.** Duffie, J.A.; Beckman, W.A.; Klein, S.A.; Mitchell, J.W. (Univ. of Wisconsin, Madison). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to develop simulation and design methods for solar energy processes. The proposed work is in the following three areas: (1) development of TRNSYS components to further enhance the TRNSYS program in the areas of industrial process heat, controls, passive heating, photovoltaics, multizone buildings, chemical heat pumps, and thermosyphon systems; (2) development of design procedures for solar thermal processes (further development of phi-bar, and phi-bar,f-chart approaches and development of components like FCHART); and (3) providing services to TRNSYS and FCHART users on the operation of their programs. Progress is summarized.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 28586, 28642, 28643, 28644, 28656, 28657, 28764, 28765, 28771, 28772, 28776, 28802, 28824, 28829, 28831, 29224, 29235, 29240

28681 (CONF-800340—) **Proceedings of the annual DOE active solar heating and cooling contractors' review meeting.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). 1980. 409p. NTIS, PC A18/MF A01.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Separate abstracts were prepared for 110 of the 116 papers included. Six papers were previously included in the data base. (WHK)

28682 (CONF-800340—, pp 1.5-1.6) **Development of an advanced Rankine/Rankine solar heating and cooling system.** McDonald, G. (AiResearch Manufacturing Co., Torrence, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this program is to design, develop, and field-test a family of integrated solar heating and cooling systems. The heat pump package operates in two basic modes, heating and cooling. In the heating mode, it operates as a heat pump to raise the temperature level of the solar-heated water to a higher level more suitable for heating a building (e.g., from 50° or 60°F to 120°F). The heat pump permits solar energy to be collected at lower temperatures, which in turn permits more efficient collector operation. This means that less costly collectors of lower performance may be used, thus improving the cost-effectiveness of the total solar system. In the cooling mode a solar Rankine engine drives the compressor of a reverse Rankine cycle cooler. Development is described.

28683 (CONF-800340—, pp 1.7-1.10) **Development of a high temperature solar powered water chiller.** English, R.A. (Carrier Corp., Syracuse, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This program has been undertaken to develop a high temperature solar powered chiller in the 15 to 25 ton size range utilizing 250 to 300°F solar hot water. The project is to study, design, and test a prototype air cooled Rankine powered vapor compression cycle which utilizes auxiliary electric energy. The design concept being developed is a dual loop, Rankine power cycle driving a Rankine vapor compression cycle. A single working fluid, R-113, is used and both loops are connected to a common air cooled condenser. The prime mover is a high speed turbine directly driving a centrifugal compressor. Under design conditions, the chiller will produce 25 tons at 44° leaving chilled water, 95°F entering condenser air and 290°F solar hot water. The cycle employs a regenerator and a suction gas heat exchanger which act synergistically to increase cycle efficiency. Program status is outlined. (WHK)

28684 (CONF-800340—, pp 1.11-1.12) **Steam Rankine engine for solar cooling.** Kolenc, T.; Keba, J.; Martin, J. (Energy Technology, Inc., Garfield Heights, OH). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the current program phase is to demonstrate a high efficiency, hybrid Rankine engine for solar cooling. The engine is designed to utilize both low and high grade energy sources in combination. This capability significantly reduces the size of the solar collector required by the system, and thus greatly decreases system capital cost. The key element of ETI's hybrid steam Rankine engine is a multi-stage radial outflow (ROF) turbine. The basic construction of the turbine involves two parallel discs; one rotating, the other stationary. The working fluid (steam, in this case) enters at the center, flows radially outward through concentric alternating stator and rotor blade rows mounted on the discs. By utilizing a multi-stage design, subsonic flow can be maintained in each of the individual turbine stages. This yields high turbine performance at off-design conditions which is an important design characteristic for the solar cooling application where the vast majority of the operating hours are spent at part load. Progress is reported. (WHK)

28685 (CONF-800340—, pp 1.13-1.18) **Rankine cycle solar driven heat pump development (1976 to 1979).** Graf, J.C. (General Electric Co., Philadelphia, PA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The development, principles of operation, performance, and economics of the solar Rankine cycle-driven heat pump under development by General Electric are discussed. The system utilizes evacuated tube collectors and a two-stage multivane expander. (WHK)

28686 (CONF-800340—, pp 1.19-1.21) **Solar heating and cooling development.** Scarborough, S.E. (Honeywell, Inc., Roseville, MN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this program are to (1) develop, deliver and support prototype solar heating and combined heating and cooling studies, hardware and systems for: (a) single-family residences (3 ton), (b) multifamily residences (25 ton), and (c) commercial (25 to 50 ton); (2) design, fabricate and deliver a prototype high-temperature (300°F) 24-ton Rankine-assisted chiller; (3) perform a cost study to identify combined heating and cooling systems and installation cost reductions; and (4) design, fabricate and deliver a 16-KVA Rankine-assisted power generation module. Progress is reported.

28687 (CONF-800340—, pp 1.22-1.25) **Chiller driven by a solar steam-powered Rankine engine (SSPRE).** Lior, N.; Yeh, H. (Univ. of Pennsylvania, Philadelphia). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is the design, fabrication, testing and analysis of a solar-powered heat engine/vapor compression cycle chiller of 15 to 25 ton capacity. The chiller shall be designed for efficient operation with solar-heated fluid supply temperatures of 220° to 300°F, and be air-cooled. Progress is reported. (WHK)

28688 (CONF-800340—, pp 1.26-1.29) **Development of a solar-powered 18-ton Rankine cycle heat pump.** Biancardi, F.R.; Melikian, G.; Sitler, J.W. (United Technology Corp., E. Hartford, CT). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

United Technologies has designed, built and is testing a unique thermally-driven heat pump, sized for multi-family residential applications. This prototype unit was specifically designed to operate at peak temperatures typical of medium-concentration collectors and to permit efficient air cooling. The basic heat pump design data was developed under prior ERDA- and DOE-sponsored programs in which the operational feasibility and performance characteristics of a laboratory Rankine-cycle turbocompressor heat pump and air conditioning system were demonstrated. System design, testing, performance, and economics are described.

28689 (CONF-800340—, pp 2.1-2.4) **Overview-absorption/Rankine solar cooling program.** Wahlig, M.; Heitz, A.; Boyce, B. (Lawrence Berkeley Lab., CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Brief descriptions are given for DOE-funded R and D projects on solar absorption chillers and solar Rankine cycle chillers. Contractors include Arkla, Carrier, University of Texas at Austin, LBL, BNL, EIC Corporation, Southern Research Institute, Institute of Gas Technology, University of Maryland, United Technologies

Research Center, University of Pennsylvania, and Energy Technology, Inc. (WHK)

28690 (CONF-800340—, pp 2.5-2.8) **Unitary solar heating/cooling system package development.** Merrick, R.H. (Arkla Industries, Inc., Evansville, IN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The development, operation, and testing of an evaporatively cooled 3 ton solar air conditioner and a 25 ton Arkla WFB300 solar absorption chiller applying the unitary system approach are described. (WHK)

28691 (CONF-800340—, pp 2.9-2.12) **Development of a single family absorption chiller for use in a solar heating and cooling system.** Biermann, W.J. (Carrier Corp., Syracuse, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

A chemical composition has been identified which meets the criteria for developing a truly air cooled adsorption chiller within a short time frame. The system comprises an absorbent of lithium bromide and ethylene glycol in a weight ratio of 4.5:1, with water as refrigerant and 1-nonylamine as an additive. Laboratory testing has established all the chemical properties needed to utilize this system. A 10 kW (3 tons) breadboard machine has been built and operated to refine the design numbers and identify any potential engineering problems. The prototype machine has been constructed to provide 10 kW (3 tons) of cooling with 110°C (230°F) solar heated water at an ambient temperature of 35°C (95°F) with a thermal coefficient of performance of 0.76. (WHK)

28692 (CONF-800340—, pp 2.13-2.14) **Prototype modular 15 ton solar absorption air conditioning system.** Biermann, W.J. (Carrier Corp., Syracuse, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

A design concept for a low temperature absorption chiller, proven in a previous Bonneville Power Administration contract has been completed and extended to become a unitary package for solar space heating and cooling. One version of this package, using flat plate collectors and a steam energy supplement, has been installed in Tyler, Texas. A second version, using evacuated tubular collectors in a draindown configuration, and employing an electrical driven heat pump for auxiliary heating and cooling, has been installed in the Big Eddy site of Bonneville Power Administration.

28693 (CONF-800340—, pp 2.17-2.18) **Multiple effect absorption cycle analysis.** Vliet, G.C. (Univ. of Texas, Austin). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

There appears to be potential for application of double effect absorption cycle cooling with solar-thermal input, because of an improved cycle co-efficient of performance (COP). The primary objective of this project is to develop a numerical model of the double effect absorption cycle which is then to be used to examine the effect on cycle performance (COP, capacity and limits of operation) of varying the several system input and design parameters. Specifically hot, cooling and chilled water temperature effects will be examined, in addition to the size and location of heat exchangers in the system. Secondary objectives are to consider the magnitude of the corrosion problem, to project costs of double effect systems manufactured in quantity and to examine the feasibility of refrigerant/solution storage within the double-effect cycle. The program status is summarized.

28694 (CONF-800340—, pp 3.1-3.4) **National solar desiccant cooling program.** Hooker, D.W.; Arnold, F.H. (Solar Energy Research Inst., Golden, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This paper briefly describes the concepts under development by Department of Energy desiccant cooling contractors, the status of these efforts and the work remaining, and the efforts underway in SERI's desiccant cooling research program.

28695 (CONF-800340—, pp 3.5-3.6) **Development of a solar desiccant dehumidifier.** Rousseau, J. (AiResearch Manufacturing Co., Torrance, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This program is aimed at the design and development of a 1-1/2-ton solar desiccant air conditioner (SODAC) for residential application. Status of the program is outlined. (WHK)

28696 (CONF-800340—, pp 3.7-3.8) **Open cycle lithium chloride solar cooling.** Loef, G.O.G. (Colorado State Univ., Fort Collins, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The specific objective of the project is the measurement of mass transfer (water vapor transfer) rates in packed columns in which lithium chloride solutions are reconcentrated by vaporization into a heated air stream. This information is needed for design of open cycle lithium chloride absorption cooling systems in which solar heated air provides the energy for operation. Progress is reported.

28697 (CONF-800340—, pp 3.9-3.10) **Development of a solar desiccant dehumidifier.** Lavan, Z.; Gidaspow, D. (Illinois Inst. of Tech., Chicago). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The principal objectives are design, construction, testing and mathematical simulation of cross-cooled dehumidifiers and desiccant sheets. The novel aspect of the system is a cross-cooled dehumidifier constructed from aluminum and paper-like sheets of silica gel made by a unique process developed under this contract. This dehumidifier has a number of distinct advantages: (1) low regeneration temperatures (~ 150°F); (2) low pressure drop (high EER); (3) better sorption dynamics; (4) higher cooling capacity; and (5) higher COP. Progress is described.

28698 (CONF-800340—, pp 3.11-3.13) **SOLAR-MEC development.** Macriss, R.A.; Wurm, J. (Inst. of Gas Tech., Chicago, IL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

IGT is currently developing under contract to DOE an advanced version of the SOLAR-MEC open-cycle solar desiccant heating/cooling system, for engineering field testing and ultimate commercialization. The advanced features of this residential-size unit (SOLAR-MEC III) are staged desiccant reactivation, unbalanced flow heat exchange, non-asbestos desiccant moisture exchanger, and new burner and seal systems. Program status is described.

28699 (CONF-800340—, pp 3.14-3.16) **Systems evaluation study of solar desiccant cooling systems.** Duffie, J.A.; Mitchell, J.W. (Univ. of Wisconsin, Madison). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to develop reliable and useful models of the components of solar desiccant air conditioning systems. The performance predicted by these models will be validated with experimental results. Simulation methods will be used to evaluate various system configurations in a variety of applications. The major accomplishments of the project to date have centered around the development of component models for desiccant air conditioning systems. This has involved models for rotary and fixed bed dehumidifiers, sensible heat exchangers, evaporative coolers, and building sensible and latent loads. The results from simplified analogy models have been compared to those from detailed mechanistic models. The effect of desiccant properties, and the properties of an ideal desiccant have been considered. Preliminary simulations of the performance of three candidate system types (ventilation mode, recirculation mode, and Dunkle cycle) have been explored. The project is in the early stages and definitive conclusions on system viability cannot be drawn at this time.

28700 (CONF-800340—, pp 3.17-3.20) **Integrated solar zeolite collector.** Tchernev, D. (Zeopower Co., Natick, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The goal of the first year effort is to design, construct and test an integrated zeolite collector, capable of providing hot water during the day and chilled water at night, which will act as one-for-one replacement for existing hot water solar collectors. The specific objectives are: (1) to develop zeolite collector units that provide maximum heating/cooling capability at minimum cost; and (2) to construct and test prototypes of such collectors. The goal of the second year effort is to evaluate the performance of the integrated solar zeolite collector under different climatic conditions in different parts of the USA. The specific objectives are: (3) to construct a sufficient number of operating zeolite collectors that provide maximum heating and cooling capability; and (4) to install and instrument such collectors at a number of different geographic sites in the United States and to collect data on their operating performance under a variety of weather conditions. Progress is reported.

28701 (CONF-800340—, pp 4.1-4.4) **Solar assisted heat pump program overview and summary of work at Brookhaven National Laboratory.** Andrews, J.W. (Brookhaven National Lab., Upton, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the solar assisted heat pump program is to produce an energy efficient HVAC system utilizing solar energy and electric powered heat pumps which will be optimized according to

cost, performance, reliability, and utility impact. Program status is described. (WHK)

28702 (CONF-800340—, pp 4.5-4.8) **Solar assisted heat pump studies: heat pump hardware and experiments, simulations, earth coupling contracts and supporting contracts.** Kush, E.A. (Brookhaven National Lab., Upton, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The status of the heat pump hardware development contracts, the results to date of the BNL in-house heat pump experiments, the progress of the contractual effort in earth coupling, and the activities of various supporting contracts are summarized. (WHK)

28703 (CONF-800340—, pp 4.9-4.12) **Multiple slide screw compressor.** Shaw, D.N. (Dunham-Bush, Inc., West Hartford, CT). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to develop the best possible compressor for use in Series Solar Heat Pump Systems. The compressor must be able to operate at extremely high efficiency levels from a compression ratio as low as 1.5 up to a compression ratio as high as 6.5. The compressor must have the capability to efficiently and continuously adjust to the widely varying inlet flow requirements as dictated by the operating conditions of the Series Solar Heat Pump System. The capacity of the developed compressor will be nominally 25 tons of heating when utilizing Refrigerant 22. The compressor shall be the helical screw type with multiple slides in order to accomplish the stated objective. Project status is described.

28704 (CONF-800340—, pp 4.13-4.14) **Ground coupled solar assisted heat pump performance.** Shelton, S.V. (E-Tech, Inc., Atlanta, GA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This program is designed to collect field data on residential ground coupled solar assisted heat pump systems in four different geographical areas. Two concepts are being evaluated using low temperature solar collectors, an earth heat exchanger, and a water to air heat pump. The program status is described.

28705 (CONF-800340—, pp 4.15-4.16) **Phoenix/City of Colorado Springs solar assisted heat pump project: Phase III.** Jardine, D.M. (Kaman Sciences Corp., Colorado Springs, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to stimulate the development of a preferred ground coupled solar assisted heat pump system through improving the performance and design data base for this system by conducting Engineering Field Tests for the system on different types of building applications in different climatic regions of the United States. Progress is reported.

28706 (CONF-800340—, pp 4.17-4.19) **Development of marketable solar assisted heat pump.** Hundt, R. (Lennox Industries, Inc., Carrollton, TX). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The optimum design of solar-assisted heat pumps for rapid commercialization is under investigation. A study to determine the size of heat pump for the greatest marketability is discussed. The study indicated that it is desirable to design and market a 2.5 ton unit and a 3 ton unit. (WHK)

28707 (CONF-800340—, pp 4.20-4.23) **Development of a solar assisted heat pump for the heating and cooling of buildings.** Ecker, A.L. (Northrup, Inc., Hutchins, TX). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The hardware development of optimized high efficiency vapor compression cycle heat pumps for use in conjunction with solar assisted heat pump (SAHP) systems was the primary focus of this development program. While the overall scope of the design effort included the formulation of SAHP system designs for residential, multi-family and commercial building schemes, the principal effort was directed towards the residential application. A systematic development approach consisting of several distinct program phases inluding system design and evaluation, heat pump detailed design, hardware fabrication and testing were undertaken. In addition, a marketing analysis and plan for commercializing these systems was assembled. The goal of the program was to develop the hardware for SAHP systems which offer increased performance with minimal cost impact. With the concomitant energy savings that accrue from the use of these systems, the impetus is thus provided for the marketing of SAHP systems, on a broad basis, as an economically justifiable alternative to conventional space conditioning equipment. Progress is reported.

28708 (CONF-800340—, pp 4.24-4.27) **Design and field testing of solar-assisted earth coils.** Bose, J.E. (Oklahoma State Univ., Stillwater). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to design and operate a set of instrumented field experiments to obtain engineering information and data needed for optimum design of ground energy coupling devices for use in solar-assisted heat pump systems. The field experiment addresses energy coupling configurations for both horizontal pipes in trenches and vertical coils or geo-thermal wells. Procedures are to be developed to determine the proper balance between what is collected and stored in the ground, rejected to the ground, and extracted from the ground by the heat pump. Program status is described.

28709 (CONF-800340—, pp 4.28-4.29) **Low-cost heating and cooling using a direct-expansion solar collector and heat pump.** Saaski, E.W. (Sigma Research, Inc., Richland, WA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Development of an analytical model and construction of a solar-assisted heat pump system have been pursued. The model and test unit have been used to evaluate the various factors affecting system performance and economics. The results of these analyses and tests have been used for model verification and control development. The final goal is to develop and demonstrate an optimized collector and control system. The system design and performance are briefly discussed. (WHK)

28710 (CONF-800340—, pp 4.30-4.33) **SAHP-2: analytical selection of marketable SAHP systems.** Kahan, W. (Singer Co., Fairfield, NJ). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The program objective is to identify the configurations of solar assisted heat pump (SAHP) systems and associated components that have the best market potential for the various climate regions of the United States, the primary criterion for best marketability being lowest life cycle cost relative to alternative systems. To achieve the program objective, an efficient analytical model is used to compare the thermal and economic performance of the following competing six systems: (1) an all electric resistance heating system; (2) a stand-alone heat pump system; (3) a stand-alone solar energy system; (4) a series SAHP system; (5) a parallel SAHP system; and (6) a dual source SAHP system. For each system (where appropriate) the collector area and storage volume are sized by means of the model to yield an economically optimum system. Thus, optimized systems are compared and ranked according to their marketability. This comparison is to be performed in a number of US climates to assess the dependence of system rank on climate.

28711 (CONF-800340—, pp 4.34-4.35) **Instrumentation and monitoring of the Twin Crown Realty buildings in Denver, Colorado.** Hays, D.K. (Solar Environmental Engineering Co., Inc., Fort Collins, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The Crown Monitoring project has two distinct tasks which are of importance to the solar community. The first is a performance comparison of the two solar augmented heat pump systems; one of which is an air collection system with the other being a liquid collection system. The second task is to simulate real-time data filtering, reduction and analysis on the data gathered from the two systems. Progress is reported.

28712 (CONF-800340—, pp 5.1-5.9) **Overview of solar collector and materials R and D for active buildings: materials, engineering, and collector development for space and water heating.** Bankston, C.A. (Los Alamos Scientific Lab., NM). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

A brief overview of the activities and accomplishments of the 100 projects that constitute the solar collector and materials R and D program is presented. The program includes basic studies in collector engineering and materials as well as the development of collectors for heating, cooling and heat pump applications.

28713 (CONF-800340—, pp 5.10-5.11) **Solar space heating systems using annual heat storage.** Hooper, F.C. (Univ. of Toronto, Canada). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this project are generally to investigate solar space heating systems utilizing annual storage of solar heated water and carry on research to establish the relationship between the primary weather variables and the optimum system configuration. The primary objective is to develop a simple algorithm allowing calculation of the optimum system. Progress is reported.

28714 (CONF-800340—, pp 5.12-5.15) **Development of a site-fabricated building-integrated air solar heating system.** Temple, P.L. (Total Environmental Action, Inc., Harrisville, NH). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The general goal of this project was the development of a cost-effective, durable, site-fabricated solar air heating system. The specific objectives of the study were: (1) development of a site-fabricated solar air heater design with performance comparable or superior to presently available manufactured systems, but which can be installed at only one-half the cost of the manufactured systems; (2) development of the air heater design so that it can be cost-effectively integrated into building structures in the majority of potential building situations with a minimum of construction problems; and (3) development of sufficient technical and economic data, drawings, and other information to promote the application of the design. Accomplishments are described.

28715 (CONF-800340—, pp 7.13-7.15) **Direct contact liquid-liquid heat exchanger for solar heated and cooled buildings.** Karaki, S. (Colorado State Univ., Fort Collins). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the current phase of the project is to establish the technical feasibility and economic practicability of using direct contact liquid-liquid heat exchangers in solar heating cooling systems. The project is described.

28716 (CONF-800340—, pp 7.27-7.28) **Market assessment of active solar heating and cooling products, Category B: a survey of decision-makers in the HVAC marketplace.** Johnston, P.E.; Lilien, G.L. (OR/MS Dialogue, Inc., Cambridge, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the project is a comprehensive evaluation of the market for solar heating and cooling products, both for new construction and replacement/retrofit markets. The project's focus is on identifying decision makers and evaluating their solar knowledge, attitudes and behavior. The data collected during the course of the study is analyzed to identify the prime determinants of market acceptance of solar products. This information will aid both government and private decision making in programs designed to accelerate the commercialization of active solar systems.

28717 (CONF-800340—, pp 7.29-7.31) **SOLERAS cooling projects.** Davis, R.E. (Solar Energy Research Inst., Golden, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The jointly funded $100 million five-year international agreement (SOLERAS) between Saudi Arabia and the United States was undertaken to promote the development of solar energy technologies of interest to both nations. Five engineering field tests of active solar cooling systems funded under the SOLERAS agreement for installation and operation in the US southwest are described.

28718 (CONF-800340—, pp 8.1-8.8) **Active heating/cooling systems support.** Bishop, C.J. (Solar Energy Research Inst., Golden, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Support to the active heating and cooling program involves many varied activities including analysis, testing, validation, engineering handbook development/dissemination and management. Work performed by the Solar Energy Research Institute (SERI), its subcontractors, and other laboratories/institutions in the area of systems support since the last review meeting, held in September 1978, is described.

28719 (CONF-800340—, pp 8.9) **Solar cooling systems evaluation.** Curran, H.M. (Hittman Associates, Inc., Columbia, MD). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The project objective is to provide assistance to Lawrence Berkeley Laboratory in the management and evaluation of DOE solar cooling contracts, and to perform related research activities. Accomplishments are outlined.

28720 (CONF-800340—, pp 8.10) **DOE/NASA systems development.** Richardson, W.F. (George C. Marshall Space Flight Center, Huntsville, AL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The DOE/NASA Development for Demonstration Program for solar cooling systems implementation was initiated in 1975 with the release of a series of five requests for proposals (RFP's). These were: (404) system design and development; (405) system integration of subsystems; (406) systems with additional development; (407) subsystems with additional development; and (408) marketable subsystems. The contracts awarded under RFP 404, Systems Design and Development, are briefly reviewed. These contracts are with Honeywell Incorporated, General Electric, and AiResearch. (WHK)

28721 (CONF-800340—, pp 9.1) **Overview of solar collector and materials R and D for active building systems: development of low temperature collectors for heat pump applications.** Bankston, C.A. (Los Alamos Scientific Lab., NM). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

A brief overview of the activities and accomplishments of the 100 projects that constitute the solar collector and materials R and D program is presented. The program includes basic studies in collector engineering and materials as well as the development of collectors for heating, cooling and heat pump applications. The development of low-temperature, low-cost collectors for heat pump applications is discussed.

28722 (CONF-800340—, pp 9.2-9.3) **Overview of solar collector and materials R and D for active building systems: development of high-temperature collectors for solar cooling applications.** Bankston, C.A. (Los Alamos Scientific Lab., NM). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

A brief overview of the activities and accomplishments of the 100 projects that constitute the solar collector and materials R and D program is presented. The program includes basic studies in collector engineering and materials as well as the development of collectors for heating, cooling and heat pump applications. The development of high temperature collectors for Rankine cycle and absorption cooling is discussed.

28723 (CONF-800340—, pp 10.1-10.4) **Overview of the Solar Controls Program.** Groome, L. (Solar Energy Research Inst., Golden, CO); Warren, M.L. 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The Solar Controls Program is a support element of the Solar Heating and Cooling Program of the Office of Solar Applications. In the past, work in this area has included assessment of controls needs for active solar systems and the development of control algorithms and hardware. During the past year, control problems have been identified as a major source of solar energy system malfunctions. These problems, if unresolved, will present a barrier to commercialization of active solar systems. The emphasis of the controls program has accordingly been shifted to focus on solving these near term problems related to controller reliability and system design and operation. Effective system control is the key to getting the highest performance and maximum cost effectiveness from in a solar system. Accordingly, the analysis and testing of system control strategies has been and also will continue to be a major element of the controls program plan. Progress is reported.

28724 (CONF-800340—, pp 10.5-10.8) **Optimal control of SHAC systems.** Winn, C.B. (Colorado State Univ., Fort Collins). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this program are to investigate optimal control strategies for SHAC and off-peak storage systems and also to investigate the applicability of optimal estimation procedures to SHAC systems. Accomplishments and future activities are reported.

28725 (CONF-800340—, pp 10.9-10.12) **Study of control instabilities in solar heating and cooling systems.** Herczfeld, P.; Fischl, R. (Drexel Univ., Philadelphia, PA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The purpose of this study was to develop control models and simulation techniques that correctly describe the behavior of the controller, including cycling and other forms of instabilities. The model was utilized to analyze the sensitivity of controller performance to various system parameters and control strategies. Progress is reported.

28726 (CONF-800340—, pp 10.13-10.16) **Novel control strategies for solar systems that reduce electric utility peak loads.** Lorsch, H.G. (Franklin Research Center, Philadelphia, PA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to reduce peak demands on electric utilities from solar heating/cooling backup systems by developing novel control strategies. Accomplishments and future activities are described.

28727 (CONF-800340—, pp 10.17-10.18) **Controls for solar heating and cooling.** Warren, M.L.; Schiller, S.R.; Wahlig, M. (Lawrence Berkeley Lab., CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The LBL solar controls program has three principal objectives: (1) to use the LBL test facility to evaluate experimentally the relative performance of different solar heating control strategies for a variety of input meteorological conditions and output load demands. The project will compare proportional as well as on/off collector loop control strategies. Experimental evaluation of the cost effectiveness of controllers and control strategies is expected to be the primary output of this task; (2) to analyze problems in the control of active solar systems that affect system performance and reliability: review literature to determine causes of controller failures and make recommendations for corrective measures, evaluate the potential for the use of microprocessors and advanced controllers and control strategies for the control of active solar systems; carry out theoretical studies of collector and load loop performance in support of the experimental work; (3) to perform technical support activities as part of the Systems Analysis and Controls program element of the DOE solar heating and cooling R and D program. Program support tasks include program planning, preparation and evaluation of solicitations, proposal reviews, and technical monitoring of Department of Energy (DOE) solar controls contracts. Progress is reported.

28728 (CONF-800340—, pp 11.18-11.22) **TRNSYS simulation of chemical heat pumps for solar heating, cooling and storage. Part II: simulations for Washington, DC and Fort Worth, Texas including window effects.** Offenhartz, P. O'D. (EIC Corp., Newton, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

TRNSYS-compatible subroutines for the simulation of chemical heat pumps have been written, and simulations (including heating, cooling, and domestic hot water) have been performed for Washington, DC and Ft. Worth, Texas. Directly weekly comparisons of the H_2SO_4/H_2O and $CaCl_2/CH_3OH$ cycles have been carried out, and an approximate comparison with a conventional hot water storage system has been made. In all cases simulated, the solar collector is a fixed evacuated tube system, which is necessary because chemical heat pumps operate at higher solar collector temperatures ($> 100°C$) than conventional solar systems. With standard residential loads, the chemical heat pumps performed surprisingly well. In the Ft. Worth climate, less then 45 m^2 of collectors were required to meet over 90% of the heating and cooling loads. In Washington, DC, the area required to meet the cooling load was smaller (as little as 20 m^2, depending on window shading), but was sufficient to meet only 50 to 60% of the heating load. Direct solar gains through the windows were found to contribute the majority of the cooling load in Washington, and 25% of the cooling load in Ft. Worth.

28729 (CONF-800340—, pp 12.1-12.5) **Solar heating and cooling of buildings: systems research, development and testing.** Karaki, S.; Ward, D.S.; Duff, W.S.; Lof, G.O.G.; Winn, C.B. (Colorado State Univ., Fort Collins). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

There are currently four solar heating and cooling systems under development and testing in three solar houses at Colorado State University. Two liquid systems are in Solar House I, an air system is in Solar House II and a liquid system in in Solar House III. Over the past six years, more than a dozen different system configurations have been evaluated and compared. System components have consisted of two site-built collectors, four commercial factory-built flat-plate and evacuated tube collectors, two experimental evacuated tube collectors, five heat storage subsystems, three absorption cooling systems, a nocturnal evaporative cooling system, and five types of auxiliary heat supply units including an off-peak electric heat storage unit. Performance of the various systems developed and tested at CSU have been reported previously. Research being conducted with current systems are reported and the systems and results are described separately.

28730 (CONF-800340—, pp 12.6-12.8) **Solar cooling studies and systems analysis.** Anand, D.K.; Allen, R.W. (Univ. of Maryland, College Park). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the research is to: (1) integrate the past and current University of Maryland work in component modeling and system simulation with similar activities taking place in the mainstream of the national solar cooling program; (2) continue the cooling systems analysis work, transient component modeling and develop a simplified cooling design technique; (3) formulate a methodology for a fair comparative assessment of current projects developing solar absorption chillers and systems; (4) prepare a state-of-the-art paper on absorption cycle fluids; (5) provide technical assistance in reviewing proposals and reports, and in conducting site visits, in support of the national solar cooling program; (6) conduct additional tasks as may be requested in support of the national solar cooling program; and (7) system simulation studies in the photovoltaic-thermal area. Progress is outlined.

28731 (CONF-800340—, pp 12.9-12.10) **Solar heating and cooling system analyses.** Morehouse, J.H. (Science Applications, Inc., McLean, VA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Science Applications, Incorporated (SAI) has contracted with the Solar Energy Research Institute (SERI) to perform solar heating and cooling system analyses under a basic ordering agreement. The general objective of this work is to analyze advanced solar heating and cooling (SHAC) system concepts for thermal and economic performance. The results of these analyses are to be used as inputs for programmatic planning of SHAC activities and efforts. Progress is reported.

28732 (CONF-800340—, pp 13.10-13.11) **Superior heat transfer fluids for solar heating and cooling applications.** Parts, L. (Monsanto Research Corp., Dayton, OH). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to evaluate commercially available, developmental, and candidate organic heat transfer fluids for solar heating and cooling applications and to provide information and guidelines for designers, manufacturers, and users of solar energy collection systems to allow them to select optimum fluids for their specific systems and applications. Progress is outlined.

28733 (CONF-800340—, pp 13.19-13.20) **Survey and evaluation of available thermal insulation materials for use on solar heating and cooling systems.** Cheng, B.H.; Gift, R.D. (Versar, Inc., Springfield, VA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this work was to survey and evaluate existing insulation materials for use in solar collectors and other solar heating and cooling system components. Progress is reported.

28734 (COO—4094-80) **Review of combined photovoltaic/thermal collector: solar assisted heat pump system options.** Sheldon, D.B.; Russell, M.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET2079. 7p. (CONF-800451—2). NTIS, PC A02/MF A01.

From 5. annual heat pump technology conference; Stillwater, OK, USA (14 Apr 1980).

The advantages of using photovoltaic (PV) and combined photovoltaic/thermal (PV/T) collectors in conjunction with residential heat pumps are examined. The thermal and electrical power requirements of similar residences in New York City and Fort Worth are the loads under consideration. The TRNSYS energy balance program is used to simulate the operations of parallel, series, and cascade solar assisted heat pump systems. Similar work involving exclusively thermal collectors is reviewed, and the distinctions between thermal and PV/T systems are emphasized. Provided the defrost problem can be satisfactorily controlled, lifecycle cost analyses show that at both locations the optimum collector area is less than 50 m^2 and that the parallel system is preferred.

28735 (DOE/NASA/CR—161420) **Solar heating and hot water system installed at St. Louis, Missouri. Final report.** (Tao (William) and Associates, St. Louis, MO (USA)). Apr 1980. Contract EG-77-G-01-4085;EX-76-A-29-1024. 72p. NTIS, PC A04/MF A01.

Information is provided on the solar heating and hot water system installed at the William Tao and Associates, Inc., office building in St. Louis, Missouri. The information consists of description, photos, maintenance and construction problems, final drawing, system requirements and manufacturer's component data. The solar system was designed to provide 50% of the hot water requirements and 45% of the space heating needs for a 900 square foot office space and drafting room. The solar facility has 252 square foot of glass tube concentrator collectors and a 1000 gallon steel storage tank buried below a concrete slab floor. Freeze protection is provided by a propylene glycol/water mixture in the collector loop. The collectors are roof mounted on a variable tilt array which is adjusted seasonally and is connected to the solar thermal storage tank by a tube-in-shell heat exchanger. Incoming city water is preheated through the solar energy thermal storage tank.

28736 (DOE/NASA/CR—161437) **Solar heating system installed at Telex Communications, Inc., Blue Earth, Minnesota. Final report.** (Telex Communications, Inc., Blue Earth, MN (USA)). 26 Oct 1979. Contract AC01-76CS32376;AI01-76CS31024. 178p. NTIS, PC A09/MF A01.

The final results are summarized of a contract for space heating a 97,000 square foot building which houses administrative offices, assembly areas and warehouse space. Information is also provided on system description, test data, major problems and resolutions, performance, operation and maintenance manual, manufacturer's literature, and as-built drawings. The system began delivering space heating in February 1978. The Telex solar system is composed of four main subsystems; they are the solar collectors,

controls, thermal storage and heat distribution. The ITC/Solar Mark III collector was used. The collector array consists of 10 rows of 36 collectors each. The control subsystem controls the operation of the system pumps and control valves. Thermal storage for the system is provided by a 20,000 gallon water storage tank located inside the building. Heating is accomplished by water-to-air heat exchangers and controlled by thermostats.

28737 (DOE/NASA/CR—161442) **Solar Heating and Cooling Demonstration Project at Radian Corporation, Austin, Texas. Final report.** (Radian Corp., Austin, TX (USA)). May 1980. Contract AI01-76CS31024;AC01-76CS32396. 37p. NTIS, PC A03/MF A01.

This document is the final technical report of the solar energy facility located at the Radian Corporation, Austin, Texas, 78766. This system has been operational since April 1977. Major components of this system include 36 Northrup collectors, a 1500 gallon fiberglass thermal storage tank, an ARKLA absorption cooling unit and cooling tower, a Servel heating coil, pumps, heat exchanger, and a conventional backup heating and air conditioning unit. System controls consist of a dual-stage thermostat, a control panel, a differential temperature controller, and three absolute temperature controllers. The system is designed to operate in several modes with evaluation of each mode. System performance monitoring is accomplished through 47 sensors which are sampled and recorded every five minutes by a data acquisition system. An on-site-monitor test set allows instantaneous testing and evaluation. This report also references Monthly Performance Reports, a Solar Energy System Performance Evaluation Report, a Solar Project Cost Report and a Solar Project Description Report for this site which are available through the National Technical Information Service.

28738 (DOE/NASA/CR—161444) **Solar energy facility at North Hampton Recreation Center, Dallas, Texas. Final report.** (Travis-Braun and Associates, Inc., Dallas, TX (USA)). May 1980. Contract AC01-76CS32543;AI01-76CS31024. 156p. NTIS, PC A08/MF A01.

The solar energy system is installed in a single story (two heights), 16,000 sq ft building enclosing a gymnasium, locker area, and health care clinic surrounded by a recreational area and athletic field. The solar energy system is designed to provide 80 percent of the annual space heating, 48 percent of the annual space cooling, and 90 percent of the domestic hot water requirements. The solar energy system includes a 238 single glazed flat plate, 3650 sq ft area collector subsystem, a 6000 gallon hot water storage subsystem, a domestic hot water preheat subsystem, an absorption chiller subsystem with a 2000 gallon tank chilled water storage subsystem. The auxiliary back up system is a gas-fired boiler and a conventional 100 gallon natural gas water heater provides any additional energy to satisfy hot water load requirements. A summary of project information, project chronology, project costs, the five modes of system operation, description of the Site Data Acquisition System, system performance summary, experience recommendations, system operational verification, drawings and major component manufacturers information are provided.

28739 (DOE/NASA/CR—161450) **Solar energy system performance evaluation: seasonal report for Decade 80 House, Tuscon, Arizona.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). May 1980. Contract AI01-76CS31037. 54p. NTIS, PC A04/MF A01.

The solar energy system was designed to provide domestic hot water and a 3200 square foot floor area with space heating and space cooling to a one-story, single family residence located in Tuscon, Arizona. The solar energy system consists of a 1923 square foot flat plate collector array subsystem, a 3000 gallon tank storage subsystem, pumps, controls and heat transfer medium lines. A propylene glycol (30 percent) and water (70 percent) solution is used as the energy collection and heat transfer medium. The collector-to-storage loop also contains a heat exchanger used to heat a swimming pool. The domestic hot water subsystem consists of a 66 gallon conventional electric storage tank to which solar energy is supplied by a pump circulating water through a heat exchanger immersed in the 3000 gallon storage tank. Auxiliary energy for heating is provided by a gas-fired 150,000 Btu/hour boiler. Space cooling is provided by two absorption cycle water chillers operating in parallel. The solar energy system has four modes of operation. The analysis used is based on instrumented system data monitored and collected for at least one full season of operation. The objective of the analysis is to report the long-term field performance of the installed system.

28740 (EUR—6695-EN) **Investigation of passive heating and cooling work in Europe.** Lebens, R.M.; Arch, B.; Birch, H.J. (ARCAED, London (UK)). 1980. 78p. NTIS (US Sales Only), PC A05/MF A01.

The following subjects are covered: a brief history of passive solar work, definitions of passive solar design systems, available passive solar design methods, monitoring, meteorological data for passive solar work, passive solar research in Europe, passive solar buildings in Europe, and recommendations for future work. (MHR)

28741 (EUR—6696-EN) **Feasibility study on a solar house heating system with a low quality thermal flow.** Eggers-Lura, A. (A/S International Solar Power Co. Ltd., Gentofte (Denmark)). 1980. 227p. NTIS (US Sales Only), PC A11/MF A01.

The present project is a study of a solar energy/heatpump house heating system with a low quality thermal flow, and of its integration into prefabricated concrete element buildings. Denmark's energy problem, its energy policy, and its housing and building industry are briefly described. A survey is made of existing buildings in Europe which use high-density walls/roofs as solar collectors, and of R and D work being undertaken in EEC on concrete solar collectors. A detailed study is made of the components that comprise a solar heating system integrated into a prefabricated concrete building structure. Conclusions are drawn from the work of phase I. Phase II of the project is a feasibility study of a solar/heatpump heating system integrated into a prefabricated one-family dwelling of the dense, low-level type. Firstly the parameters are considered. Thereafter descriptions of the building and its heating system are given. Heat balance calculations private-economy and energy-economy calculations of the house and its alternative heating system are presented, and finally recommendations are made as to future work. The study report comprises a large number of illustrations, tables, and technical enclosures.

28742 (EUR—6741-EN) **Selective optical coatings on plastic sheet for inexpensive radiation insulation of visible windows. Final report.** Howson, R.P. (Loughborough Univ. of Technology (UK)). 1980. 66p. NTIS, PC A04/MF A01.

Transparent conducting oxide films have been produced by reactive ion plating onto glass and plastic substrates at room temperature. The electrical properties of these films were sufficient, with high values of electrical mobility and carrier density, to give a sharp plasma reflectance edge in the near infra-red. These properties are ideally suited for the production of visibly transmitting, infra-red reflecting surfaces needed for heat mirror applications. Optimum properties were achieved with careful control of the gas mixture and amount of substrate bias acquired by the substrate from the radio frequency used for the discharge. Satisfactory films could be made starting from evaporation or planar magnetron sputtering sources. The oxides giving satisfactory properties include those of indium, indium doped with tin, indium doped with fluorine and cadmium/tin. The latter system is of particular interest because of the availability and low cost of the starting material. Heat mirrors have been made from very thin film sandwiches of silver and gold in various dielectric using evaporation and sputtering. The known system of TiO_2 - Ag - TiO_2 gave the best performance when the TiO_2 was evaporated and the silver sputtered. A system of great potential interest that was introduced and constructed was that of Si - Ag - Si which gave an adequate performance. It has been demonstrated that ion plating of established optical material can give much greater mechanical abrasion resistance to a plastic surface. Tests of the thermal performance of lm^2 windows with simulated heat mirror systems has demonstrated that an improvement in the performance of a double glazed unit can be obtained so that it is close to that of a cavity brick wall. ($U = 1.2\ Wm^{-20}C^{-1}$).

28743 (HUD-PDR—514) **Selling the solar home '80: market findings for the housing industry.** (Real Estate Research Corp., Chicago, IL (USA)). Jan 1980. 28p. GPO $3.00.

An overview of the current 1980's market for solar heated and cooled houses is presented. The study is based on the first, second, and third demonstration program grants awarded by HUD under the Solar Heating and Cooling Demonstration Act of 1974. The market data collection process included interviews with industry, public officials, and consumers. Profiles are provided of the typical demonstration solar house, builder, and purchaser. Considerations in planning the solar home and designing and building the home for the local market are reviewed. The attitudes and interests of the potential solar home purchaser are discussed and a profile of buyers and nonbuyers is presented; frequently asked questions are listed. Techniques and promotional tools for attracting solar home buyers are reviewed and the reactions of purchasers living in a solar house are cited. The general outlook for the solar housing market is discussed and is considered encouraging.

28744 (LA—8385-T) **Similitude modeling of natural convection heat transfer through an aperture in passive solar heated buildings.** Weber, D.D. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 124p. NTIS, PC A06/MF A01.

Thesis.

An experimental study of natural convection heat transfer through a doorway in a two room passive solar heated building is described. Similitude modeling was the method used to measure natural convection heat transfer coefficients (h/sub NC/) in a model geometrically scaled down by a factor of 5. Freon gas was used as the working fluid to obtain dynamic similarity within the model. A

temperature difference was maintained between the two rooms by a heated vertical wall which simulated a Trombe wall in one room, and by a cooled vertical wall which simulated a thermal storage wall in the other room. Heat transfer through the doorway was measured as a function of a characteristic temperature differential (ΔT/sub ave/) and the geometry of the doorway. The geometric factors investigated were the door height to ceiling height ratio (AHR) and the door width to partition width ratio (AWR). For building design considerations, ΔT/sub ave/ was chosen to be the difference betweeen volume weighted temperature averages of the two rooms. Relationships between h/sub NC/ and ΔT/sub ave/ were expressed in terms of the non-dimensional similarity numbers for natural convection systems, the Nusselt number (Nu), the Grashof number (Gr), and the Prandtl number (Pr), in the form Nu/Pr = C(Gr)/sup a/. A general relationship for h/sub NC/ was written in the form Nu = K(AHR)/sup b/(AWR)/sup c/Gr/sup a/ for the variables investigated here. Similarity numbers were calculated using the ceiling height H as the characteristic length to evaluate the influence of AHR and AWR on h/sub NC/. For comparison with previous works, and with a theoretical expression developed in this work, the doorway height d was used as the characteristic length. Heat transfer rates were measured for values of the Grashof number Gr/sub d/ in the range $1.3 \times 10^8 \leq Gr/sub\ d/ \leq 1.3 \times 10^9$. Experimental data are presented and discussed.

28745 (SERI/TP—731-631) **Open-cycle absorption cooling using packed-bed absorbent reconcentration.** Leboeuf, C.M.; Loef, G.O.G. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 8p. NTIS, PC A02/MF A01.

The technical feasibility of a lithium chloride open-cycle absorption air conditioner using solar-heated air for reconcentration of the absorbent solution is examined. In contrast to a successfully operating Soviet design (in which absorbent reconcentration is accomplished by trickling the solution across a sloping black roof exposed to the sun), this study involves a packed-bed concentrator. Solar-heated air reconcentrates the solution by vaporizing water (the refrigerant) from the solution in the packed bed, enabling the system to be incorporated into a conventional solar air heating system and avoiding numerous problems associated with the roof concentrator. A thermodynamic analysis provides the criteria for the design of the packed bed. Heat and mass transfer processes occurring simultaneously in the bed are modeled using an iterative technique with the aid of a digital computer. The size of the packed-bed required to reconcentrate the absorbent solution at a rate corresponding to 10,550 W of cooling is determined, using flow rates, temperatures, and humidities typical of residential solar air-heating systems. Based on these results, the system air conditioning capability with solar energy input is predicted over the course of a clear summer day for Fort Collins, Colorado, and St. Louis, Missouri. Sufficient cooling capacity to meet a 10,550 W peak load using a 70 m^2 flatplate collector array is predicted by the model for both locations.

28746 (SERI/TR—98150-3) **TRNSYS-compatible, standardized load model for residential system studies. Final report.** Hughes, P.J.; Morehouse, J.H. (Science Applications, Inc., McLean, VA (USA)). Jun 1980. Contract AC02-77CH00178. 93p. NTIS, PC A05/MF A01.

A standard load model is presented for use in residential forced air HVAC (active solar or conventional) system analysis. The model is TRNSYS-compatible and is designed for temperature level control. Three locations are selected with a typical conventional (not passive) residence defined at each through the specification of load model parameters. Use of the model with specified parameters provides a means of comparing heating and cooling systems while interfaced with an identical load forcing function. The load model is described in detail and a FORTRAN listing is provided. A validation of the load model and the interactive versus pre-calculated load issue are both described in an analytical comparison. An example problem, illustrating how to use the model in a TRNSYS simulation, is also provided.

28747 (SOLAR/2004—78/60) **Solar project cost report for Trinity University Power Plant No. 2, San Antonio, Texas.** (Mueller Associates, Inc., Baltimore, MD (USA)). 1979. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01.

Detailed cost information for the Trinity University Power Plant No. 2 solar hot water, space heating, and space cooling project located in San Antonio, Texas, is given. This retrofit solar energy system supplies space heating, cooling, and hot water for six dormitories and an athletic complex, a total of approximately 285,000 square feet of building space. The 15,633 net square feet of Northrup tracking, concentrating collectors are mounted on the top flat roofs of the athletic complex. Solar thermal energy is stored in two 20,000 gallon buried steel storage tanks. The construction costs of this solar heating and cooling project are presented. Category costs are listed by materials, direct labor, and subcontract costs. Subcontract costs include both materials and labor costs. No further breakdown of costs could be obtained. The installed cost of the system was $958,210, not including contractors' overhead and profit and general and administrative costs. A more detailed account of the data base and category cost components is provided.

28748 (SOLAR/2014—78/60) **Solar project cost report for Blakedale Professional Center, Greenwood, South Carolina.** (Mueller Associates, Inc., Baltimore, MD (USA)). 21 Apr 1978. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01.

Cost information is provided for the solar heating and hot water system at the Blakedale Professional Center located in Greenwood, South Carolina. The solar energy system provides space heating and domestic hot water for half the office space at the Blakedale Professional Center. The system construction was concurrent with the building construction. The system utilizes three banks of collectors, with a net area of 928 ft^2 and a gross area of 954 ft^2, roof monted in a sawtooth configuration with aluminized mylar reflectors on the backs of the supports. The collectors are double glazed and have copper absorber plates with a nonselective black coating. Storage capacity is 5000 gallons and is provided by a steel storage tank covered with polyurethane insulation buried underground approximately 50 feet from the building. The installed costs of the system was $47,855 in 1976 dollars not including general contractor overhead and profit, construction management fees, and general and administrative costs. (MHR)

28749 **Services and resources of the National Solar Heating and Cooling Information Center.** Fultz, G. (National Solar Heating and Cooling Information Center, Philadelphia, PA). pp 4p, Paper 6 of State energy audit impact '80 conference. Norcross, GA; American Inst. of Industrial Engineers (1980).

From State energy audit impact '80 conference; St Louis, MO, USA (31 Mar 1980).

The National Solar Heating and Cooling Information Center is mandated by Congress to accelerate the commercialization of solar heating and cooling by compiling and disseminating information. The Center has developed a data bank and toll-free telephone hot-line. The data base information includes listings of solar equipment manufacturers, legislation, professionals, installations, speakers, testing and standards, climatic, and economic data. Reference materials from the Solar Document Center are not available to the public. Technical support is provided by the Demonstration Data Base and several publications. The Center is a cooperating member of the Solar Energy Information Data Bank at the Solar Energy Research Institute, maintaining close contact with other members. (DCK)

28750 **G-CHART: a new simplified method for applying solar.** Lameiro, G.F. (Colorado State Univ., Ft. Collins). pp 125-128 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

The utilization of the GCHART sizing procedure for designing solar energy space and domestic hot water heating systems is described. This method was developed at the national Solar Energy Research Institute under the name of the GFL method. The GCHART method can be applied to both air and liquid solar collection systems. Its primary advantages are its relative ease of usage and the small amount of time required to use the method, typically about ten minutes. The method requires only ten steps to perform and does not require either a computer or a hand-held programmable calculator. The method has been validated by running thousands of examples.

28751 **Solar house plans II-A.** Thomason, H.E.; Thomason, H.J.L. Jr. Barrington, NJ; Edmund Scientific Company (1978). 70p.

Blueprints are provided for a new design of solar house with conventional styling. The cost of installing solar heating, air conditioning and solar collector panels is discussed. (SPH)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 28808

28752 (DOE/CS/32198—1) **Solar production of industrial process steam for the Lone Star Brewery. Final report.** Deffenbaugh, D.M.; Watkins, P.V.; Hugg, S.B.; Kulesz, J.J.; Decker, H.E.; Powell, R.C. (Southwest Research Inst., San Antonio, TX (USA)). 29 Jun 1979. Contract ET-78-C-03-2198. 128p. NTIS, PC A07/MF A01.

This report outlines the detailed design and system analysis of a solar industrial process steam system for the Lone Star Brewery. The industrial plant has an average natural gas usage of 12.7 MMcf per month. The majority of this energy goes to producing process steam of 125 psi and 353°F at about 50,000 lb/h, with this load dropping to about 6000 lb/h on the weekends. The maximum steam production of the solar energy system is about 1700 lb/h. The climatic conditions at the industrial site give 50% of the possible amount of sunshine during the winter months and more than 70% during the summer months. The long-term yearly average daily total radiation on a horizontal surface is 1574 Btu/day-ft^2, the long-term yearly average daytime ambient temperature is 72°F, and the per-

centage of clear day insolation received on the average day of the year is 62%. The solar steam system will consist of 9450 ft² of Solar Kinetics T-700 collectors arranged in fifteen 90-ft long rows through which 67.5 gpm of Therminol T-55 is pumped. This hot Therminol then transfers the heat collected to a Patterson-Kelley Series 380 unfired steam boiler. The solar-produced steam is then metered to the industrial process via a standard check valve. The thermal performance of this system is projected to produce about 3 million lbs of steam during an average weather year, which is approximately 3 billion Btu's. As with any prototype system, this steam system cannot be justified for purely economic reasons. It is estimated, however, that if the cost of the collectors can be reduced to a mass production level of $3 per lb then this type of system would be cost effective in about six years with the current government incentives and a fuel escalation rate of 10%. This period can be shortened by a combination of an increased investment tax credit and an accelerated depreciation.

28753 (SERI/TR—733-323) **Industrial process heat case studies.** Hooker, D.W.; May, E.K.; West, R.E. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 121p. NTIS, PC A06/MF A01.

Commercially available solar collectors have the potential to provide a large fraction of the energy consumed for industrial process heat (IPH). Detailed case studies of individual industrial plants are required in order to make an accurate assessment of the technical and economic feasibility of applications. This report documents the results of seven such case studies. The objectives of the case study program are to determine the near-term feasibility of solar IPH in selected industries, identify energy conservation measures, identify conditions of IPH systems that affect solar applications, test SERI's IPH analysis software (PROSYS/ECONOMAT), disseminate information to the industrial community, and provide inputs to the SERI research program. The detailed results from the case studies are presented. Although few near-term, economical solar applications were found, the conditions that would enhance the opportunities for solar IPH applications are identified.

28754 **Solar energy and the search for emission offsets: a proposal.** O'Brien, K.M.; Euser, B. *Sol. Law Rep.;* 1: No. 6, 1076-1079(Mar 1980).

The use of solar energy in providing both offsets and in reducing the pollution of new or expanded industrial plants enough to avoid altogether the need to go through offsetting process is discussed. Although it is relatively expensive now for the most common industrial application, industrial process heat (IPH), solar energy may be attractive to some industries, especially in the long term, when compared in cost with the combination of conventional energy production and pollution control equipment.

28755 **Solar industrial processes.** Curto, P.A. pp 129-137 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

Studies conducted over the last three years have indicated an extremely large market potential for solar industrial process heat systems. Engineering analysis for optimized system configurations provided both cost and performance parameters for mass-produced and standardized modular designs for a market simulation model. Sensitivity analyses on economic conditions, fuel price and availability projections, and a large diversity of proposed Federal incentives were performed in comparison to a baseline scenario reflecting the provisions of the proposed National Energy Act. The results indicate that three generic solar thermal power systems will predominate in the industrial and utility sectors for process heat - the parabolic dish, the central receiver and variations of the evacuated tube collector. The results of the year by year simulation include market capture, deployed collector by type and temperature range, regional (geographical) distributions, and financial requirements. It appears that, based on the simulations, several billion square feet of solar process heat systems may be in place by the year 2000.

WATER HEATING

REFER ALSO TO CITATION(S) 28580, 28656, 28681, 28712, 28728, 28734, 28735, 28738, 28747, 28748, 28750, 28776, 28802, 29235

28756 (CONF-800340—, pp 6.10-6.12) **Development of a gas backup water heater properly integrated with solar heated domestic hot water storage tanks.** Morrison, D.J. (Altas Corp., Santa Cruz, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The current contract aims at the development of engineering prototype hardware for an efficient gas-fired backup heater for solar DHW systems. Current designs are inadequate. Electrical backup heaters are not a viable answer in areas in which gas is available. Progress is reported.

28757 (CONF-800340—, pp 6.13-6.15) **Solar hot water system test program.** Fanney, A.H.; Liu, S.T.; Hill, J.E. (National Bureau of Standards, Washington, DC). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Several computer codes are being widely used to predict the thermal performance of solar domestic hot water (SDHW) systems. However, they need to be validated with experimental data to justify their wide use. One objective of this project is to conduct controlled experiments on typical state-of-the-art solar domestic water heaters and to determine the extent to which existing computer programs can accurately predict their performance. A second objective is to investigate alternate methods of testing the systems for the purpose of rating and to support the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) in developing a standard test procedure. Progress is described.

28758 (CONF-800340—, pp 6.16) **Installation and checkout handbooks for solar domestic hot water systems.** Winn, C.B. (Solar Environmental Engineering Co., Inc., Fort Collins, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this effort includes the preparation of two separate handbooks. The first is a Domestic Hot Water (DHW) Systems Checkout Handbook, which will contain procedures for checking the operation of an installed DHW system. The second is a Controls Handbook for Designers and Installers of Solar Domestic Hot Water Systems, which will contain guidelines for the design and installation of DHW control systems. A third task covers technical support to SERI in the overall Systems Analysis and Testing Program. Progress is outlined.

28759 (CONF-800340—, pp 6.17-6.19) **Controls and installation and checkout handbooks for solar DHW systems.** Winn, C.B.; Sharp, K.; Leflar, J.; Kent, T. (Solar Environmental Engineering Co., Inc., Fort Collins, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this project are to: (1) provide system checkout and service procedures that may be used to quickly determine the thermal performance of solar DHW systems; and (2) provide design and installation guidelines for designers and installers of DHW control systems. The handbooks are described.

28760 (CONF-800340—, pp 11.29) **Monitoring of thermal stratification of the storage tank of the Mabel Lee Hall solar hot water system.** Anderson, E.E. (Univ. of Nebraska, Lincoln). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The principal objective of this project is to obtain an experimental data base for stratification in liquid storage tanks. This data base should be extensive enough to be used for verification of free convection stratified storage computer codes under a variety of operating modes. For verification purposes, the data base must include measurements of the inputs and outputs to the storage medium as well as measurements throughout the storage volume. All measurements need to be taken on a regular time cycle throughout a test. A wide variety of operating modes should also be included in order that the data base may be as extensive as possible. Progress is reported.

28761 (DOE/NASA/CR—161466) **Solar energy system performance evaluation: seasonal report for Elcam Tempe Arizona State University, Tempe, Arizona.** (IBM Federal Systems Div., Huntsville, AL (USA)). May 1980. Contract AI01-76CS31037. 71p. NTIS, PC A04/MF A01.

The analysis used is based on instrumented system data monitored and collected for at least one full season of operation. The objective of the analysis is to report the long-term field performance of the installed system and to make technical contributions to the definition of techniques and requirements for solar energy system design. The solar system, Elcam-Tempe, was designed to supply commercial domestic hot water heating systems that utilize two, four by eight foot flat plate collectors to heat water in a fifty-two gallon preheat tank or a fifty-two gallon domestic hot water (DHW) tank. The DHW tank provides hot water to the Agriculture Department residence at Arizona State University. The system uses an automatic cascade control system to control three independent actuators, the coolant circulation pump, the cascade valve, and the electric heating element. The system provides freeze protection by automatically circulating hot water from the hot water tank through the collectors when the collector outlet temperature is below a specified value. The building is a single story residence located at the agriculture experiment farm of the Arizona State University. The Elcam-Tempe Solar Energy System has four modes of operation.

28762 (MLM—2739(OP)) **Miamisburg salt-gradient solar pond: mid-1980 status report.** Wittenberg, L.J.; Harris, M.J. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 22p. (CONF-800737—1). NTIS, PC A02/MF A01.

From Non-convective solar pond workshop; McLean, VA, USA (30 Jul 1980).

The largest salt-gradient solar pond in the US was constructed by the City of Miamisburg, Ohio to provide heat for an outdoor swimming pool in the summer and an adjacent recreational building from October to December. The pond which occupies an area of 2020 m^2 was installed for \$35/m^2 and is conservatively estimated to provide 1012 GJ/year (960 million Btu) at a cost of \$6.80/GJ (\$7.20/MBtu). During July to September 1979, 143.5 GJ (136 million Btu) of heat was utilized. Several unpredicted operational concerns have been noted related to corrosion of the metallic heat exchanger and the failure of selected seams in the plastic liner. Based upon two years of experience, suggestions are made to prevent or minimize these difficulties.

OTHER

REFER ALSO TO CITATION(S) 28631

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 28617, 28642, 28643, 28644, 28700, 28709, 28712, 28714, 28721, 28722, 28733, 28752, 28762, 28839

28763 (ALO—4291-1) **Statistical model for assessing the risk of hail damage to any ground installation. Technical report, June 1978-March 1979.** Cox, M.; Armstrong, P.R. (Altas Corp., Santa Cruz, CA (USA)). Sep 1979. Contract EM-78-C-04-4291. 115p. NTIS, PC A06/MF A01.

This report describes a statistical model which has been developed to determine the risk of damage by large hail to any ground installation (such as a solar flat plate collector). The model is based on data for the number of haildays per year, hailstone size distribution, and storm severity (expressed in number of hailstones per square meter per storm). Other than parameters derived from the raw meteorological data available, the parameters of the model are the number of years of surface exposure and the exposure area size. The end result is the probability of a hailstone of a given size striking a given surface area in a given number of years. The maximum probable hailstone size is used as a convenient index of hail risk. The data upon which to base a prediction model are sparse at this time, covering few geographic locations; much of the information available is deficient in sampling consistency and/or sample size. For this reason, this report fully documents the derivation and use of the model for future applications, when more and better data are collected. The FORTRAN source code to calculate the risk model digitally is included in APPENDIX D. This model improves on previous work in: (1) the use of more thorough statistical procedures and a more rigorous accounting of storm severity; (2) a more thorough investigation into the two probability density distributions commonly used (Poisson and negative binomial) to describe hailday frequencies, and (3) an attempt to define more rigorously the distribution of hailstone sizes. A sensitivity analysis was performed and conclusions are drawn from the results.

28764 (ANL—79-96) **Corrosion behavior of several metals in ethylene glycol-base heat-transfer fluids under conditions encountered in solar energy systems.** Zeman, G.J. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 53p. NTIS, PC A04/MF A01.

The corrosion behavior of aluminum, copper, and iron in inhibited ethylene glycol-ASTM corrosive water solutions was evaluated in a laboratory loop under isothermal and heat-flux conditions for 1000 h at temperatures between 378 and 413°K, in static autoclave tests at 450°K for 500 h, and by potentiodynamic polarization measurements at temperatures between 298 and 348°K. The effect of time, temperature, and ethylene glycol concentration of the heat-transfer fluid on the extent of inhibitor depletion was determined from analyses of the reserve alkalinity, pH, and inhibitor content of the solutions. The performance of an electrochemical sensor as a monitor of fluid quality was also evaluated. A heat flux of 0.4 to 1.0 kW/m^2 did not have a significant effect on the corrosion behavior of the various materials at temperatures between 378 and 413°K. The corrosion rates of aluminum, copper, and iron in the 50 volume percent inhibited ethylene glycol-corrosive water solution decreased as a function of time during the 1000-h test. At 413°K, the corrosion rate of copper was considerably higher than that of iron or aluminum at low flow velocity. Significant degradation of the fluid quality, as indicated by the measurement of the pH, reserve alkalinity, and inhibitor concentrations, occurred after several hundred hours at temperatures of ~ 450°K.

28765 (CONF-800340—, pp 7.16-7.17) **Self controlling, self pumping heat circulation system study.** Wachtell, G.P. (Franklin Research Center, Philadelphia, PA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The work performed by the Franklin Research Center (FRC) in a one-year study of self controlling, self pumping heat circulation systems for solar applications is described. The purpose of self pumping is to transport heat from solar collectors to the thermal energy storage (TES) or point of use without using utility power. Self pumping schemes that were evaluated are: power cycles for moving air or liquid or for use in vapor/liquid (latent heat) systems, vapor bubble lift (liquid), vapor expansion (liquid), entrainment of condensate by vapor (latent heat), injector (liquid), pulsejet (liquid), fluidyne (liquid), osomotic pumping (latent heat), capillary pumping (latent heat), negative thermal expansion coefficient for downward thermosyphoning (gas and condensed phase), magnetic forces on ferrofluids (liquid), and electrostatic forces on dielectric fluids (liquid). Principal findings are summarized. (WHK)

28766 (CONF-800340—, pp 7.22-7.23) **Solar pond studies: Phase III.** Bryant, H.C. (Univ. of New Mexico, Albuquerque). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to continue to investigate the physics of a full-scale, salt-gradient solar pond now entering its fifth season of operation on the UNM north campus. Theoretical, numerical and experimental studies of pond behavior, which should lead to suggestions for improved pond design are described. (WHK)

28767 (CONF-800340—, pp 7.24-7.26) **Salt-gradient solar pond development.** Nielsen, C.E. (Ohio State Univ., Columbus). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This project has two major objectives. The first objective is to obtain accurate experimental energy balance data from an operating salinity gradient solar pond for comparison with calculations from a numerical model. Given agreement between observation and computation for this one case, it becomes possible to predict with some confidence the performance to be anticipated for a range of environments and operating conditions. The second objective is to develop improved methods of observation for pond monitoring and to develop pond management procedures that will insure reliable pond operation. Progress is described.

28768 (CONF-800340—, pp 9.4-9.6) **Test results on vacuum tube collectors.** Wiesenmaier, B.L. (Marshall Space Flight Center, Huntsville, AL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this in-house Marshall Space Flight Center (MSFC) test activity are: (1) evaluate the applicability of ASHRAE Standard 93-77 for testing vaccum tube collectors; (2) provide methodology for comparing vacuum tube collectors; and (3) relate experience to testing other collector types and improving collector standards. Test results and conclusions are discussed. (WHK)

28769 (CONF-800340—, pp 9.7-9.8) **Further development of a low-cost solar panel.** Nelson, E.V.; Muller, T.K. (Acurex Corp., Mountain View, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The overall objective of this program is to develop a single-glazed, liquid-heating, nonconcentrating collector which is cost-effective and can be rapidly commercialized. The primary applications for the collector will be space heating, water heating and process heat, at temperatures from 120°F to 170°F. The specific goal of the current 1-year contract is to fabricate, test, and gain operational experience on a full-scale prototype panel section, with emphasis on the unglazed version. The program also includes an assessment of alternate manufacturing methods and costs to take advantage of the experience gained in designing, fabricating, and testing these panels. Progress is reported.

28770 (CONF-800340—, pp 9.9-9.10) **Evaluation of hail protection needs and devices for solar flat plate collectors.** de Winter, F. (Altas Corp., Santa Cruz, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives are to determine the incidence of potentially damaging hail on flat plate collector systems, and to develop guidelines for cost effective protection schemes to be used where necessary. A general hail risk model has been developed, based on hailpad data collected by the National Weather Service. The model is based on statistical distributions of hailstone size, number of hailstones per unit area per storm, and number of haildays per year in a given location. In addition, user-supplied parameters are the surface area exposed to hail and the number of years of exposure. The model is used to calculate the maximum probable hailstone size which is a

convenient index for conducting impact testing. Altas has conducted tests on tempered glass, Fiberglass, reinforced polyester (FRP), and screens as possible protection devices. The threat of vandalism to solar collectors has also been evaluated. Progress is summarized. (WHK)

28771 (CONF-800340—, pp 9.11-9.13) **Evaluation of solar collectors for heat pump applications.** Skartvedt, C.G. (American Heliothermal Corp., Denver, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Program objectives are: (1) evaluate the potential utility of low-cost, flat plate solar collectors as the heat source/sink for solar assisted heat pump systems for space heating and cooling; and (2) conduct an experimental determination of effective night sky temperatures and convective heat transfer coefficients for surfaces with dimensions representative of flat plate solar collectors. Progress is discussed. (WHK)

28772 (CONF-800340—, pp 9.14-9.15) **Development of compound parabolic concentrators for solar heating and cooling applications.** Reed, K.A. (Argonne National Lab.,IL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is the development and commercialization of improved collector systems for solar heating and cooling applications. The improvements sought include higher operating temperatures, increased thermal efficiency, lighter weight, and lower cost. The project builds on present day technology, identifying and developing those areas necessary for reaching the objective. The project combines basic collector and system design studies with fabrication and testing of engineering prototypes of the most promising designs. To promote early commercialization, intensive industrial interaction is encouraged in all phases of the project. Progress is reported.

28773 (CONF-800340—, pp 9.16-9.19) **Development of a low-temperature, low-cost, black liquid solar collector, Phase II.** Landstrom, D.K.; Talbert, S.G.; McGinniss, V.D. (Battelle Columbus Labs., OH). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The primary objective of the Phase II program is to evaluate several candidate plastic materials and solar collector designs suitable for black liquid use, prior to specific development for commercial entry. Secondary objectives are: (1) to obtain sufficient data to design a full-scale demonstration of the black liquid collector in a commercial application; (2) to team with a company willing to commercialize black liquid plastic collectors; (3) to recommend suitable plastics, coatings, designs, and applications which will allow long-life and good performance; (4) to investigate overall system performance for variations in design, materials, and specific uses; and (5) to monitor and incorporate improved black liquids. Progress is reported.

28774 (CONF-800340—, pp 9.20-9.21) **Transpired solar air heaters.** Buchberg, H.; Edwards, D.K. (Univ. of California, Los Angeles). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this investigation is to establish and prove the technical merit of two transpired solar air heater types: honeycomb, porous-bed absorber configurations and slotted flat and vee-corrugated selective black plate absorber configurations and to validate the performance of a full-scale experimental air heater representing the best concept of those studied. Progress is reported.

28775 (CONF-800340—, pp 9.22-9.23) **Study of aluminum corrosion in aluminum solar heat collectors using aqueous glycol for heat transfer.** Wong, D. (Giner, Inc., Waltham, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The main objective of this program is to determine means whereby light gauge aluminum solar heat collector panels operating on aqueous glycol heat transfer fluids can be safely used over long periods of time without suffering from significant corrosion problems. The intermediate objectives are: (1) to investigate the characteristic changes of glycol solutions due to aging at elevated temperatures; (2) to determine the corrosiveness of these aged glycol solutions to aluminum; (3) to measure the critical pitting potential of aluminum in aqueous glycol; and (4) to prepare a corrosion control manual. The program status is discussed.

28776 (CONF-800340—, pp 9.24-9.27) **Solar collector studies for solar heating and cooling applications.** Brittle, P.N.; Yenamandra, R. (InterTechnology/Solar Corp., Warrenton, VA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this study was to provide a survey of mirror and lens solar concentrator collectors suitable for space heating, cooling, and hot water applications. The survey, which continued through November 1979, has served two main purposes: (1) to provide DOE with detailed comparative design performance and delivered energy cost data which can be directly utilized in their R and D planning; and (2) to provide the user community with this information presented in an understandable format so that the relative merits of each collector can be evaluated. Accomplishments are summarized.

28777 (CONF-800340—, pp 9.30-9.31) **Low-cost mirror concentrations, based on double-walled, metallized, tubular films.** Ball, G.L. III; Schwendeman, J.L.; Leffingwell, J.W. (Monsanto Research Corp., Dayton, OH). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The purpose of this work was to develop an innovative nontracking cylindrical mirror concentrator of about 3X concentration ratio that utilizes inflation for shape generation and film type plastic materials and processes to minimize cost. Low cost and moderate performance were to be emphasized. The project status is summarized.

28778 (CONF-800340—, pp 9.32-9.34) **Development of standard methods for testing solar collectors.** Jenkins, J.P.; Streed, E.R.; Hill, J.E. (National Bureau of Standards, Washington, DC). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to develop standard testing procedures that can be used for testing and rating of solar collectors that are used in systems for heating, cooling, and heating of hot water in buildings. Progress is reported.

28779 (CONF-800340—, pp 9.35-9.36) **Evaluation of heat transfer enhancement in air-heating collectors.** Mattox, D.L. (Northrop Services, Inc., Huntsville, AL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The effort was to identify techniques for enhancing the heat transfer between the absorber and the air stream, develop methods of performance comparison for widely diverse designs, determine optimum Reynolds number flow regime for solar collector operation, develop theoretical prediction relationships for scaling state-of-the-art designs, and to make recommendations for further research. Accomplishments are described.

28780 (CONF-800340—, pp 9.37-9.39) **Advanced heat transfer studies in flat plate solar collectors.** Churchill, S.W.; Lior, N.; Yeh, H. (Univ. of Pennsylvania, Philadelphia). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the research is to study heat convection in solar collectors in order to understand how to reduce heat losses from water-heating and air-heating solar collectors. In particular, the contribution of internal natural convection and external free convection to these losses and their coupling with irradiation, re-radiation, thermal conduction and convection to the working fluid are under investigation. Results are reported.

28781 (CONF-800340—, pp 9.40-9.42) **Collector array studies.** Lior, N.; Yeh, H. (Univ. of Pennsylvania, Philadelphia). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives are: (A) to determine the optimized configuration of collector rows as a function of available collector-mounting area, inter-row spacing, row orientation, collector inclination, collector height, wind effects, geographic location in the US, and system cost; and (B) to determine recommended collector-array piping options (e.g., series, parallel, parallel-series) based on the determination of total system performance as a function of flow rate, collector efficiency, pumping power and system cost. Progress is reported.

28782 (CONF-800340—, pp 9.43-9.47) **Forced and natural convection studies on solar collectors for heating and cooling applications.** Pearson, J.T. (Purdue Univ., West Lafayette, IN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Specific objectives of this work are to obtain information on forced and natural convection in air-heating solar collectors through theoretical, experimental, and technological studies. Convective heat transfer and fluid mechanics relationships applicable to several solar collector configurations are being determined and will be documented in two primary areas. In Area 1, three absorber geometries are being considered: flat plate, flat plate with plane continuous and interrupted fins, and flat plate with corrugations. In Area 2, two permeable absorber geometries are considered: porous matrix and louvered surfaces. Progress is reported. (WHK)

28783 (CONF-800340—, pp 9.48-9.50) **Point focusing Fresnel solar concentrator for solar heating and cooling: a natural when you can use 250°F to 750°F.** Rogers, W.; Borton, D. (Rensselaer Polytechnic Inst., Troy, NY). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The design and development of a prototype 70 kWt collector using a point focusing Fresnel lens with a steam heating system and a steam fired absorption chiller are discussed. A microprocessor control system tracks the sun. Performance and cost are discussed. (WHK)

28784 (CONF-800340—, pp 9.51-9.52) **Image collapsing concentrators.** Sletten, C.J. (Solar Energy Technology, Inc., Bedford, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives are to develop and demonstrate new synthesis theories for the design of wide-angle Fresnel Lenses and accompanying Image Collapsing Subreflectors to maximize optical efficiencies and concentration ratios on non-tracking solar collectors. Also, it was attempted to construct a model collector and make thermal measurements on the new concentrator using vacuum and other selectively coated absorbers. Progress is reported.

28785 (CONF-800340—, pp 9.53-9.55) **Development of a high performance air heater through use of an evacuated tube cover design.** Jones, D. (Solaron Corp., Denver, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is to develop a high-temperature (170 to 230°F) solar air-heater utilizing an evacuated fluorescent light tube array. The tubes are laid parallel in a close packed array to form a transparent cover over the absorber plate. Program status is discussed.

28786 (CONF-800340—, pp 9.56-9.57) **Solar collector studies for solar heating and cooling applications.** Baum, B. (Springborn Labs., Inc., Enfield, CN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The project goal is the evaluation of weather-resistant, low-cost glazing and housing materials that will have a lifetime of up to twenty years under varying stress and high (300°F) temperature. Surface etching processes and anti-reflective coatings to reduce reflection losses and increase transmission of plastic glazing will be investigated. Durable coatings and films for uv protection of plastics will be evaluated. Progress is reported.

28787 (CONF-800340—, pp 9.58-9.59) **Wind effects on collectors.** Hewitt, H.C. Jr. (Tennessee Technological Univ., Cookeville). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The primary objective of this study was to predict the effect of wind on the efficiency of a flat-plate solar collector. Progress is reported. (WHK)

28788 (CONF-800340—, pp 9.60-9.61) **Structural integrity of solar collectors.** Chevalier, H.L.; Wilke, R.A. (Texas A and M Univ., College Station). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the project is to determine the structural load coefficients, in particular those due to wind loads, for solar panels and support structures. The data and analyses are based on reduced and full-scale models in steady and unsteady wind conditions. Both single and multiple panel configurations are considered in the project. Accomplishments are summarized.

28789 (CONF-800340—, pp 9.62-9.65) **Survey and evaluation of current design of evacuated collectors.** Graham, B.J. (Trident Engineering Associates, Inc., Annapolis, MD). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This report is to describe all of the evacuated collectors available, from those which had been tested extensively to others which were just in the stage of laboratory development. Where the information is available, the collectors are to be compared in performance and cost with a flat plate collector. A completed list of the sites using these collectors is to be compiled to show the variety and extent of use of evacuated collectors.

28790 (CONF-800340—, pp 9.66-9.67) **Heat transfer in partial vacuum.** Thomas, J.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives are: (1) to develop a rigorous theoretical analysis of gaseous conduction in evacuated solar collectors to determine the minimum partial vacuum necessary to eliminate conduction heat losses; and (2) to assess the effect of helium penetration into the evacuated region on the heat loss characteristics of evacuated collectors. Progress is reported.

28791 (CONF-800340—, pp 9.68-9.69) **Collector sealants and breathing.** Mendelsohn, M.A. (Westinghouse Electric Corp., Pittsburgh). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this program were: (1) to investigate the pertinent properties of a variety of possible sealants for solar collectors and identify the most promising candidates; and (2) to study the effect of breathing in flat-plate, thermal solar collector units. The study involved two types of sealants, Class PS which includes preformed seals or gaskets and Class SC which includes sealing compounds or caulks. It was the intent of the study to obtain data regarding initial properties of candidate elastomers from manufacturers and from the technical literature and to use those sources to provide data pertaining to endurance of these materials under environmental service conditions. Where necessary, these data were augmented by experimental measurements. Environmental stresses evaluated by these measurements included elevated temperatures, moisture, ultraviolet light, ozone and oxygen, and fungus. The second major area of the work involved a study of the effects of materials used and design on the durability of solar collectors. Factors such as design, fabrication, materials of construction, seals and sealing techniques and absorber plate coatings were observed on actual field units removed from service. Such phenomena as leakage, corrosion and formation of deposits on glazing and absorber plate were noted. An evaluation of the properties of several desiccants was made in order to provide means to mitigate the deleterious effects of water on collector life. Progress is reported.

28792 (CONF-800340—, pp 13.1) **Development of selective surfaces.** Cotsworth, J.L. (Berry Solar Products, Edison, NJ). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to investigate means of improving selective surfaces on copper, aluminum and stainless steel. Progress is briefly discussed.

28793 (CONF-800340—, pp 13.2-13.3) **Development of superior liquid coolants CCF-1.** Marinik, J.A. (Dow Corning Corp., Midland, MI). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The specific objective of this work was to establish the most cost effective solar heat transfer fluid through a comprehensive study of the four most common fluids being used. Criteria for making the assessment was the relative results of F.H.S.A. toxicological studies, fire hazards testing, thermal efficiency performances, corrosion studies, collector stagnation testing and physical property comparison data of various fluids. Progress is reported.

28794 (CONF-800340—, pp 13.4-13.5) **Development of improved insulation materials.** Rabe, J.A. (Dow Corning Corp., Midland, MI). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project was to demonstrate a cost effective silicone foam insulation offering low thermal conductivity, resistance to outgassing and moisture retention, thermal stability, and flame resistance. The effort was to include formulation adjustments to obtain a low density (1 to 5 pcf) foam, performance testing to evaluate the foam's resistance to conditions within a stagnant solar collector, and a calculation of cost effectiveness. Progress is reported.

28795 (CONF-800340—, pp 13.6) **Low-cost solar antireflection coatings.** Lin, R.J.H. (Honeywell, Inc., Roseville, MN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this program were: (1) to develop an accurate and rapid analytical method for monitoring the antireflection (AR) glass etching production process; (2) to extend the developed large-scale AR etching process to new types of glass which are now most widely used as collector covers; and (3) to improve the coating durability and demonstrate the large-scale production feasibility of organic AR coating on glass. Accomplishments are outlined.

28796 (CONF-800340—, pp 13.7-13.8) **Selective paint and black chrome coatings development.** Lin, R.J.H.; Zimmer, P.B. (Honeywell, Inc., Roseville, MN). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The purpose of this program was to improve the performance of solar selective black chrome and paint coatings. Extensive study

of the solution chemistry of the black chrome process and various undercoat/substrate combinations would lead to improved coating durability (especially thermal stability) and optical properties, improved control and reproducibility of the fabrication process, and reduced coating costs. Improving adhesion and abrasion resistance were the major concerns in the paint coating efforts, as was the development of techniques for large-scale application. Progress is reported.

28797 (CONF-800340—, pp 13.9) **Selective ir reflective coatings.** Lefkow, A.R.; Lee, J.C. (Honeywell, Inc., Roseville, MN). 1980. From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this program was the development of cost-effective methods for coating plastic solar collector glazings/windows with selective infrared (ir) reflective coatings. These greenhouse effect/heat mirror coatings enhance the performance and economic feasibility of solar collector systems, especially passive systems, and have application for reducing heat loss through building windows. The program status is outlined.

28798 (CONF-800340—, pp 13.12-13.13) **Non-glass glazings.** Pitt, C.G. (Research Triangle Inst., Research Triangle Park, NC). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this program is to determine if silicones are useful competitive glazing materials for solar collectors. The evaluation includes a determination of the effect of various accelerated weathering tests applied to silicone elastomers, low temperature potting compounds and reinforced silicone rubber. The abrasion resistance and dirt retention of such materials are also being evaluated. An economic analysis of the use of silicones as an alternative to glass glazing in flat plate collectors is being performed. Progress is summarized.

28799 (CONF-800340—, pp 13.14) **Development of polyimide materials for use in solar energy systems.** Gagliani, J. (Solar Turbines International, San Diego, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The major objective of this program is to optimize and characterize fire resistant, lightweight polyimide foams with improved insulation properties and a wide spectrum of rigidity and density for use in active and passive solar energy systems. Progress is reported.

28800 (CONF-800340—, pp 13.15-13.16) **Development of selective surfaces.** Thornton, J.A. (Telic Corp., Santa Monica, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of the program is to develop methods for producing low cost selective absorber surfaces by dc reactive sputtering using magnetron type sources. Two representative absorber coatings were selected for development as vehicles for evaluating the sputtering technology. They were metal/metal-oxide cermets of the black chrome type and a multi-layer metal/oxide coating (Al_2O_3-Mo-Al_2O_3) which is known to have superior thermal stability. In two proof-of-concept phases a cermet coating was continuously deposited on aluminum foil, and hollow cathode magnetrons were used to deposit the Al_2O_3-Mo-Al_2O_3 coatings over short tubular sections.

28801 (CONF-800340—, pp 13.17-13.18) **Studies for predictably modifying the optical constants of doped indium oxide films.** Goldner, R.B. (Tufts Univ., Medford, MA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective was to correlate the wavelength dependence of the optical constants of polycrystalline films of doped indium oxide with structure, composition, and thermal history, and arrive at a useful model of the electromagnetic behavior of doped indium oxide so that one could predictably modify its optical constants and those of related metal oxides. Indium oxide films are being studied for use as antireflection coatings on solar absorbers and solar cells. Progress is reported. (WHK)

28802 (COO—4484-07) **Self controlling, self pumping heat circulation system study. Final report, August 1, 1977-July 31, 1978.** Wachtell, G.P. (Franklin Research Center, Philadelphia, PA (USA)). 31 Jul 1978. Contract AC02-77CS34484. 153p. NTIS, PC A08/MF A01.

Self pumping methods for transporting heat from roof-mounted flat plate solar collectors to thermal energy storage (TES) at a lower elevation are described and evaluated. Several power cycles and various other devices were considered. Power cycles are feasible for sensible heat transport with air or water, and also in latent heat transport systems. Vapor bubble lift for circulating water and latent heat transport with condensate return by the vapor stream are recommended for development as devices with no moving parts. Development of an injector for circulating liquid is also recommended, although higher collector temperatures or circulants that are more volatile than water would be needed. Some methods of delivering heat to the TES using photovoltaic power or small amounts of utility power were also evaluated. These include tracking collectors with optical ducting for direct heating of the TES. All schemes that use no external power incur a thermodynamic penalty, expressible as an increase in the temperature difference needed between collector and TES. The maximum tolerable penalty was taken to be 10°F. 79 references.

28803 **Self reorienting solar tracker.** Baer, S. (to Dow Corning Corp.). US Patent 4,175,391. 27 Nov 1979. Filed date 12 Dec 1977. 4p.

Apparatus is discussed for causing a solar energy collector to constantly follow the sun by using solar radiant energy to differentially heat fluid-containing reservoirs to cause differential vaporization and shifting of fluid to rotate the apparatus. Automatic morning orientation is included by providing the easterly reservoir with a faster rate of cooling than the westerly one thereby causing shift of fluid from westerly to easterly after sunset resulting in inclination toward the east by sunrise.

28804 (DOE/CS/04239—T1) **3X compound parabolic concentrating (CPC) solar energy collector. Final technical report.** Ballheim, R.W. (Chamberlain Mfg. Corp., Waterloo, IA (USA). Research and Development Div.). 25 Apr 1980. Contract AC04-78CS04239. 208p. NTIS, PC A10/MF A01.

Chamberlain engineers designed a 3X compound parabolic concentrating (CPC) collector for the subject contract. The collector is a completely housed, 105.75 x 44.75 x 10.23-inch, 240-pound unit with six each evacuated receiver assemblies, a center manifold and a one-piece glass cover. A truncated version of a CPC trough reflector system and the General Electric Company tubular evacuated receiver have been integrated with a mass producible collector design suitable for operation at 250 to 450°F. The key criterion for optimization of the design was minimization of the cost per Btu collected annually at an operating temperature of 400°F. The reflector is a 4.1X design truncated to a total height of 8.0 inches with a resulting actual concentration ratio of 2.6 to 1. The manifold is an insulated area housing the fluid lines which connect the six receivers in series with inlet and outlet tubes extending from one side of the collector at the center. The reflectors are polished, anodized aluminum which are shaped by the roll form process. The housing is painted, galvanized steel, and the cover glass is 3/16-inch thick tempered, low iron glass. The collector requires four slope adjustments per year for optimum effectiveness. Chamberlain produced ten 3X CPC collectors for the subject contract. Two collectors were used to evaluate assembly procedures, six were sent to the project officer in Albuquerque, New Mexico, one was sent to Argonne National Laboratory for performance testing and one remained with the Company. A manufacturing cost study was conducted to estimate limited mass production costs, explore cost reduction ideas and define tooling requirements. The final effort discussed shows the preliminary design for application of a 3X CPC solar collector system for use in the Iowa State Capitol complex.

28805 (DOE/CS/12142—T1) **Investigation of sodium carbonate, sodium bicarbonate and water systems for saturated solar ponds. Final report.** (InterTechnology Corp., Warrenton, VA (USA)). 28 Mar 1980. Contract AC04-79CS12142. 66p. NTIS, PC A04/MF A01.

The overall objective of this study was to gather relevant data primarily from the published literature to investigate the technical feasibility of using a Na_2CO_3-$NaHCO_3$ mixture for a saturated solar pond. This objective was accomplished by a literature search and review of existing chemical information and by performing simple chemistry experiments in the laboratory. Information on density, solubility, phase diagram, equilibrium compositions, reaction rate constant, equilibrium constant, diffusion coefficient, vapor pressure and potentially useful additives is compiled. It is concluded that even though both the saturation density and solubility increase with temperature for trona, it is not chemically stable either at room temperature or higher temperatures (80°C). Therefore, as is, trona is not suitable for use in a saturated solar pond. From the literature it has been found that sugar and gum can retard the decomposition of bicarbonate to carbonate in the mixture. Nevertheless, trona is a very attractive solute for an unsaturated solar pond. A laboratory unsaturated pond with a stable density gradient has worked without any problems for about two months at InterTechnology/Solar Corporation.

28806 (DOE/CS/34293—T1) **Berry Group: R and D Project. SAS-1 development of selective surfaces. Technical progress report No. 3, June 2, 1980.** Cotsworth, J.L. (Berry Solar Products, Edison, NJ (USA)). 1980. Contract AC04-78CS34293. 17p. NTIS, PC A02/MF A01.

Eighty four coupons representing many solar absorption coatings and substrates were collected and have been tested under cyclic

temperature conditions. These coupons include selective and semi-selective surfaces produced by spraying, dipping, electroplating and sputtering. The tasks based on the Statement of Work are identified and the work performed is described. Accelerated testing of coupons by the Berry method is continuing and some of the results are listed. The temperature was cycled between 450 +- 35°F and 180 +- 25°F. The absorptivity and emissivity values of selective coatings after they have been exposed to 112 temperature cycles and 100,000 Btu/ft² of solar irradiation are tabulated. Electron micrographs of electrodeposited black chrome on various substrates are included. (WHK)

28807 (DOE/ET/20550—1) **Line-focus solar central power system, phase I. Subsystem experiment: receiver heat transfer.** Slemmons, A.J. (SRI International, Menlo Park, CA (USA)). Apr 1980. Contract EY-76-C-03-0115-140. 125p. NTIS, PC A06/MF A01.

Wind-tunnel tests confirmed that heat losses due to natural convection are negligible in the line-focus, solar-powered receiver. Anomalies in the forced-convection tests prevented definitive conclusions regarding the more important forced convection. Flow-visualization tests using a water table show much lower velocities inside the receiver cavity than outside, supporting the supposition that the forced-heat transfer should be less than that from a standard exposed cylinder. Furthermore, the water-table tests showed ways to decrease the low velocities in the cavity should this be desired. Further wind-tunnel testing should be done to confirm estimates and to support advanced design. This testing can be done in standard wind tunnels since only the forced convection is of concern.

28808 (GA-A—15830) **Concrete concentrator panel development program for SolarOil project, Phase I.** Nicolayeff, V.; Chow, G.S.; Koploy, M. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AC03-79CS30308. 102p. NTIS, PC A06/MF A01.

The results of the General Atomic (GA) fixed-mirror solar concentrator (FMSC) concrete panel development program are presented. The FMSC is part of the solar steam supply system proposed by GA for the SolarOil project. The program was conducted to determine the achievable accuracy of precast concrete concentrator panels and to investigate expedient and economical mass production of the panels. One steel form, two concrete forms, and three concrete panels were fabricated and about 1500 slat angle measurements made using a laser inspection fixture developed expressly for this purpose. All panels were 1.83 m (6 ft) long and had a 3.6 m (11 ft 10 in.) aperture and 71 slats. Proper concrete mixes, parting compounds, placement methods, vibrating techniques, and curing procedures were identified, and the hardware and techniques for stripping and turning the panels were tested. Based upon test results and structural calculations it was concluded that reasonably priced 5.5-m (18 ft) long panels can be produced with either steel or fiberglass-coated concrete forms with 95% to 99% of the slat area within +- 0.25° of the desired angles. With steam curing, the production rate is one panel every other working day per 5.5 m (18 ft) of form length.

28809 (MLM—2734(OP)) **Management of a large, operational solar pond.** Wittenberg, L.J.; Harris, M.J. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76-DP00053. 3p. (CONF-800806—29). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

Routine and non-routine maintenance are discussed based upon experience during the past two years at the largest operational solar pond in the United States. Routine maintenance of a solar pond, such as algae control and water clarity control, is minimal and the upkeep expense associated with this maintenance is small. Non-routine maintenance, however, can be very involved, as well as expensive. Although non-routine maintenance can consist of various problems which may arise in a pond, this paper deals only with corrosion of the heat exchanger and a leak in the containment system. With proper planning and preventive measures, even those difficult problems can be controlled and satisfactory repairs made.

28810 (SAND—79-7052) **Cleaning agents and techniques for concentrating solar collectors.** Sheratte, M.B. (McDonnell Douglas Astronautics Co.-West, Huntington Beach, CA (USA)). May 1980. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01.

Tests were conducted to determine the nature of the soil which is irreversibly deposited on solar collectors during environmental exposure. Methods of removing this soil were investigated. The mechanism of attachment of the soil to the surface was determined as a potential aid to cleaning agent formulation. Reflector specimens were exposed at sites in Shenandoah, GA, Albuquerque, NM, and Daggett, CA. Three types of reflector surfaces were studied: second surface silvered glass, aluminized FEK 244 film on glass substrate, and RTV 670 on aluminum. Cleaning procedures were evaluated by microscopic examination of the solid surfaces before and after cleaning and by measurement of specular reflectance. The potential effectiveness of environmental cleaning agents, such as rain, frost and snow, is discussed.

28811 (SAND—80-0056) **Central Receiver Test Facility software package for Boeing/Electric Power Research Institute bench model solar receiver experiment.** Porter, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01.

The development of a data acquisition and display system for use at the Central Receiver Test Facility (CRTF) in Albuquerque, New Mexico, is described. Included is a description of a mini-computer-based network developed for facility control and data acquisition, specific software developed to support the Boeing/Electric Power Research Institute (EPRI) receiver test program, and the solutions to some problems encountered.

28812 (SAND—80-1045C) **Oxidation of electrodeposited black chrome selective solar absorber films.** Holloway, P.H.; Shanker, K.; Pettit, R.B.; Sowell, R.R. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering; Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 19p. (CONF-800439—11). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

X-ray photoelectron and Auger electron spectroscopies have been used to study the composition and oxidation of electrodeposited black chrome films. The outer layer of the film is Cr_2O_3 with the inner layer being a continuously changing mixture of Cr + Cr_2O_3. Initially, approximately 40% by volume of the film is combined as Cr_2O_3, and the volume percentage of Cr_2O_3 increases to greater than 60% after only 136 hours at 250°C. After approximately 3600 hours at 400°C, the volume percentage of Cr_2O_3 increased to as high as 80%. The thermal emittance decreased approximately linearly with increasing oxide content, while the solar absorptance remained constant until the percentage of Cr_2O_3 exceeded approximately 70%. Oxidation was slower when the Cr^{+3} concentration in the plating bath was reduced from 16 g/l to 8 g/l, and when black chrome was deposited on stainless steel rather than sulfamate nickel.

28813 (SERI/TP—351-540) **Thermographic techniques applied to solar collector systems analysis.** Eden, A. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract AC02-77CH00178. 9p. (CONF-800804—20). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

The use of thermography to analyze large solar collector array systems under dynamic operating conditions is discussed. The research at the Solar Energy Research Institute (SERI) in this area has focused on thermographic techniques and equipment to determine temperature distributions, flow patterns, and air blockages in solar collectors. The results of this extensive study, covering many sites and types of collectors, illustrate the capabilities of infrared (IR) analysis as a qualitative analysis tool and operation and maintenance procedure when applied to large arrays. Thermographic analysis of most collector systems qualitatively showed relative temperature distributions that indicated balanced flow patterns. In three significant cases, blocked or broken collector arrays, which previously had gone undetected, were discovered. Using this analysis, validation studies of large computer codes could examine collector arrays for flow patterns or blockages that could cause disagreement between actual and predicted performance. Initial operation and balancing of large systems could be accomplished without complicated sensor systems not needed for normal operations. Maintenance personnel could quickly check their systems without climbing onto the roof and without complicated sensor systems.

28814 (SERI/TP—733-617) **Solar ponds and their applications.** Jayadev, T.S.; Edesess, M. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1980. Contract AC02-77CH00178. 12p. (CONF-800352—4). NTIS, PC A02/MF A01.

From 7. energy technology conference and exposition; Washington, DC, USA (24 Mar 1980).

Solar ponds are probably the simplest and least expensive technology for conversion of solar energy to thermal energy. The solar pond is unique in its ability to act both as collector and as storage. The cost of a solar pond per unit area is considerably less than that of any active collector available today. The combination of their economic and technical factors make solar ponds attractive for district heating and industrial process heat applications. Solar ponds have the potential to displace significant quantities of fossil fuel in low-temperature heating applications in nonurban areas.

28815 (SERI/TR—333-359) **Determining the optical quality of focusing collectors without laser ray tracing.** Bendt, P.; Gaul, H.; Rabl, A. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract EG-77-C-01-4042. 23p. NTIS, PC A02/MF A01.

This paper describes a novel alternative to the laser ray trace technique for evaluating the optical quality of focusing solar collectors. The new method does not require any equipment beyond what is used for measuring collector efficiency; it could therefore become part of routine collector testing. The total optical errors resulting from imperfect specularity and from inaccuracies in reflector posi-

tion or slope are characterized by an angular standard deviation σ/sub optical/, the rms deviation of the reflected rays from the design direction. The method is based on the fact that the off-axis performance of a concentrator depends on σ/sub optical/. An angular scan is performed, i.e., the collector output is measured as a function of misalignment angle over the entire range of angles for which there is measurable output (typically a few degrees). This test should be carried out on a very clear day, with receiver close to ambient temperature (if the latter conditions cannot be satisfied, appropriate corrections are necessary). The parameter σ/sub optical/ is then determined by a least-squares fit between the measured and the calculated angular scan. We tested the method on a parabolic trough collector manufactured by Hexcel, but it is suitable for parabolic dishes as well. The method appears to be accurate enough to determine σ/sub optical/ within about 10%.

28816 Solar energy collector. Roantree, W.J.; Bartini, P.S. (to Mel Modern Systems, Inc.). US Patent 4,175,540. 27 Nov 1979. Filed date 18 May 1977. 10p.

A radiation concentrating solar energy collector and a dual axis tracking support system which positions collector units to receive the maximum incident solar radiation are disclosed. A system of pressurized air is utilized as a multiple function medium which activates the tracking mechanism, inflates and supports the reflective concentrators and acts as the heat transfer medium.

28817 Solar energy collectors and plants operated by them. Laing, N.; Laing, I.; Laing, O. US Patent 4,172,766. 30 Oct 1979. Priority date 9 Oct 1974, Austria, 12p.

A solar energy collector floating on water is supported by fluid cushion and comprises elements each of them consist of a solar energy absorbing layer arranged between two heat insulating layers.

28818 Solar heat collector panel and method of forming same. Newton, T.L. (to Sunburst Solar Energy). US Patent 4,172,441. 30 Oct 1979. Filed date 26 Sep 1977. 4p.

A solar heat collector panel comprising a flat spiral coil of pipe (preferably plastic) having an inlet at the inside and outlet at the outsidw, the inlet conduit extending out behind the coil. A plurality of approximately radial ribs is attached behind the coil to support the coil spaced from the surface on which it is installed to create a dead air space, prevent dry rot of the supporting surface, hold the coil level and stiffen the panel. A sheet of plastic material is caused to adhere to the back of the coil by adhesive and vacuum molding. The method of fabricating the panel is described in detail. This invention is in improvement on U.S. Pat. No. 4,014,324. 9 claims.laims.

28819 Process for manufacturing solar collector panels. Heyman, J.H. (to American Solar Heat Corp.). US Patent 4,172,311. 30 Oct 1979. Filed date 15 Jun 1977. 6p.

Lightweight, economicla and highly effective solar energy collector panels are formed with a sheet of transparent plastic exposed to solar radiation and spaced by a rigid lightweight spacer frame above a sheet of metallic foil, which embraces in heat conducting relationship a spaced array of metal water-carrying tubes all supported by an underlying plastic foam slab, with the overall assembly being encircled by a channel section peripheral frame. By completing the panel assembly with foam material which substantially entirely encapsulates the panel components internally in an inexpensive, lightweight, and completely effective framed unit, a unique panel construction is achieved by a unque manufacturing process.

28820 Solar panel. Atkinson, J.W. US Patent 4,172,444. 30 Oct 1979. Filed date 19 Jun 1978. 6p.

An extruded solar collector is disclosed formed of and inexpensive material which may be used individually or readily assembled in groups in a series or parallel arrangement to form a panel by unskilled personnel with simple tools to provide an effective solar ray converter.

28821 Solar energy collector system and method. Boblitz, O.W. (to Bio Gas Systemss, Inc.). US Patent 4,172,442. 30 Oct 1979. Filed date 15 May 1978. 8p.

A solar energy collector system having a high energy collection efficiency simultaneously heats separate gas and liquid streams flowing through the collector. The gas flows in a tiered passage sunward of the liquid passage. Exposure times of gas and liquid are regulated by separate thermostatic controls. The heated gas and liquid may be used as energy imput for space heating, hot water, air condiioning, etc., separately or in combination. 12 claims.

28822 Value of vertical solar collectors in Iowa. Hodges, L.; Block, D.A. (Iowa State Univ., Ames). pp 4.31-4.46 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

A vertical collector will collect nearly as much (about 95% as much) solar radiation during the key heating months of December through February as a collector tilted at the optimum angle (about 70° in central Iowa). Its high performance is due to the low altitude of the winter sun and the contribution of ground (especially snow) reflection to the insolation on a vertical surface. During the summer months a vertical glazing collects the least solar radiation, a desirable feature which can be further improved by shading. Passive solar heating systems using vertical collectors are excellent choices for residences and other small buildings, and designs using the simplest construction materials (glass and concrete) can easily provide nearly all the net thermal load of the building. Since it can be simpler and less expensive to construct, a vertical collector is a viable choice for northern latitudes.

HEAT STORAGE

REFER ALSO TO CITATION(S) 28713, 28715, 28809, 28814, 29158

28823 (CONF-800340—, pp 7.9-7.12) **Studies of heat transfer and water migration in soils.** Walker, W.R. (Colorado State Univ., Fort Collins). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The principal objective of this research is the investigation of thermal properties of partially saturated soil surrounding subsurface heat storage reservoirs and heat exchange piping. Four specific objectives or tasks are planned: (1) to study the thermal conductivity of soil materials in relation to mineralogical composition, water content, and bulk density. The purpose of this objective is to provide guidelines for using available in situ soil materials around buried heat reservoirs and heat exchange piping; (2) to study the rates of soil drying around heated surfaces, particularly the width of the dry layer and its change in thermal conductivity. The purpose of this objective is to evaluate a soil's self-insulating capacity; (3) to study the water vapor permeability of water barriers which might be used as reservoir or heat exchange boundary materials. The purpose of this objective is to determine the feasibility of managing thermal properties of the soil surrounding heated or cooled buried surfaces; and (4) to study the heat exchange from in-ground piping. The purpose of this objective is to establish criteria for pipe spacing and flow rates. Progress is reported.

28824 (CONF-800340—, pp 11.1-11.6) **Summary of thermal energy storage projects.** Michaels, A.I. (Argonne National Lab., IL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The current status of contracts, the significant technical accomplishment to date and the planned future activities of contractors for thermal energy storage projects funded by the Office of Solar Applications for Buildings are summarized.

28825 (CONF-800340—, pp 11.7-11.10) **Modeling and development of thermocline and halothermocline storage systems.** Sha, W.T.; Lin, E.I.H.; Liu, K.V.; Bartzis, J.G.; Cha, Y.S. (Argonne National Lab., IL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives are to: (1) develop and validate three-dimensional stratification model (COMMIX-SA-1), porous-media model (COMMIX-SA-RD), and double-diffusive-convection model (COMMIX-SA-SP), within the framework for the investigation of heat, mass and momentum transport phenomena in thermocline and halothermocline storage systems; (2) utilize the models developed to perform parametric studies on water tanks, rock beds, and salt-gradient solar ponds so as to optimize design and improve performance of these solar-energy components; (3) design, construct and test out improved vertical and horizontal rock beds; and (4) investigate stability characteristics of salt-gradient solar pond. Progress is reported.

28826 (CONF-800340—, pp 11.11-11.12) **Stratified storage measurement and analysis.** Cole, R.L. (Argonne National Lab., IL). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this task is to provide experimental verification of the efficacy of several tank shapes and baffle and diffuser configurations for promoting thermal stratification. Comparison of experimental results with analytical predictions will be used to validate the COMMIX-SA computer code. Guidelines based on the experimental results will be written for designers of thermal energy storage tanks. Progress is described.

28827 (CONF-800340—, pp 11.13-11-14) **Developing and upgrading of solar system thermal energy storage simulation models.** Kuhn, J.K. (Boeing Computer Services Co., Seattle, WA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

Developing and Upgrading of Solar Systems Thermal Energy Storage (TES) Simulation Models is a program designed to develop high quality TES computer simulation models from the state of the art information and test data and make these models usable and available. Specifically: (1) collect, standardize, and upgrade existing TES models from the literature and other contractors; (2) correlate TES models with TES component test data; (3) develop streamlined versions of validated TES component models; and (4) provide DOE and industry with a competent solar TES simulation tool. Progress is reported.

28828 (CONF-800340—, pp 11.15-11.17) **Salt hydrate thermal energy storage system for space heating and air conditioning.** Mac Cracken, C.D. (CALMAC Manufacturing Corp., Englewood, NJ). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to develop, test and make ready for the commercial market three different salt hydrate/heat exchanger modules with on-site filling techniques to cover storage of heat pump coolness (40 to 50°F), solar or heat pump space heating (100 to 120°F), and solar energy for absorption air conditioning or Rankine engines (200 to 250°F). Progress is reported.

28829 (CONF-800340—, pp 11.23) **Solar cooling thermal energy storage study.** Curran, H.M. (Hittman Associates, Inc., Columbia, MD). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The project objective is to identify the thermal storage requirements for solar cooling systems using absorption, Rankine and desiccant technologies, and to identify research and development needs.

28830 (CONF-800340—, pp 11.24-11.25) **Development of an improved water tank for thermal storage.** Hudson, W.T.; Jones, W.M. (Independent Living, Inc., Norcross, GA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to design and develop a modular, transportable, pre-insulated, efficient, easily installed, long life thermal storage tank which can be plant manufactured and shipped to distant locations. The objective is to identify, analyze, and implement materials which can be used for such a tank, to fabricate and test the tank and provide a volume product for the solar market. The concept is to use two fiberglass shells with foam insulation between them to create a sandwich effect. Progress is reported. (WHK)

28831 (CONF-800340—, pp 11.26-11.27) **Thermal storage for solar cooling using paired ammoniated salt reactions.** Jaeger, F.A. (Martin Marietta Corp., Denver, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objectives of this program are to: demonstrate concept feasibility using subscale system testing; measure compatibility of appropriate construction materials with candidate ammoniates; select the optimum combination of ammoniates for a residential heating and cooling system; investigate system practicality by conceptual design and cost estimates of a residential unit; and demonstrate system performance by testing a full scale unit. Accomplishments are summarized.

28832 (CONF-800340—, pp 11.28) **Thermal energy storage code analysis.** Greenberg, J. (National Bureau of Standards, Washington, DC). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

This project is designed to categorize new and innovative thermal storage devices into a building code framework and to analyze these types of devices to identify potential code related problems that would prevent their commercialization, usage, or acceptance by local building code officials. Progress is reported.

28833 (CONF-800340—, pp 11.30-11.33) **Membrane-lined foundations for liquid thermal storage.** Bourne, R.C. (Univ. of Nebraska, Lincoln). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The overall project goal was to evaluate the potential for using membrane-lined foundations as economical and durable thermal storage subsystems for solar heating installations. Specific objectives were: (1) to survey existing membrane-lined storage projects; (2) to evaluate alternative membrane liner materials; (3) to develop preferred designs for structural support of membrane storage liners; (4) to develop and evaluate improved designs for heat transfer to and from membrane-lined storage containers; and (5) to evaluate concepts for stratification enhancement in membrane-lined storage containers, including baffles, multiple tanks, and tank configurational variations. Accomplishments and future activities are described.

28834 (CONF-800340—, pp 11.34) **Cost effective improvement of rock beds used in solar air heating systems.** Jones, D. (Solaron Corp., Denver, CO). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The overall objective of the project is the development of improved vertical and horizontal rock bed heat storage designs which will result in maximum cost effectiveness in solar air heating systems. Work has not yet started on this project.

28835 (CONF-800340—, pp 11.35-11.38) **Lightweight concrete materials and structural systems for water tanks for thermal storage.** Buckman, R.W. Jr. (Westinghouse Electric Corp., Pittsburgh, PA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective of this project is the development of a water storage system made with precast, or cast on-site, lightweight concrete structural and insulating elements possessing the necessary properties and capable of being easily assembled or fabricated, especially for retrofitting into and integration with existing residential and other structures. The thermal and structural property requirements for hot water storage tanks to achieve the requisite efficiency were determined in conjunction with the evolution of various conceptual tank designs. Progress is reported.

28836 (SERI/TP—631-567) **Model of direct contact heat transfer for latent heat energy storage.** Cease, M.E. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 8p. (CONF-800806—27). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

Direct contact heat transfer is an attractive method to reduce the cost of heat exchange for latent heat thermal energy storage systems. However, current performance information is insufficient to allow an accurate appraisal of its economic and technical feasibility. In a direct contact heat transfer system, an immiscible fluid is bubbled through the storage media and heat is transferred between the phases as the droplets rise. An analytical model is presented for predicting the temperature of the rising droplets from information in the literature. The drop size is calculated from empirical correlations in the jetting formation region and rise velocity is characterized by a creeping-flow surface cell model which accounts for the hindering effects of neighboring droplets. The viscosity of the crystallizing solution in the rise velocity equation is approximated by an expression for concentrated suspensions, where the percentage of solids is taken as the percentage of crystallization. Dispersed phase holdup is predicted with the rise velocity. Calculation of the rate of heat transfer to the dispersed immiscible fluid droplets is based on three different internal hydrodynamic approximations: rigid, internally circulating, and wall-mixed spheres. The predictions of the circulating drop case agree reasonably well in the latent heat region with previous data on a similar system. However, because the model is also sensitive to the estimates used for drop size, continuous phase viscosity, and interfacial tension, the heat transfer mechanism cannot be conclusively identified, and experimental research is required to establish the validity of the model.

28837 (SERI/TP—721-574) **Performance of storage walls with highly conductive covering plates and connecting fins.** Ortega, J.K.E.; Bingham, C.E.; Connolly, J.M. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 11p. NTIS, PC A02/MF A01.

The thermal behavior of a storage wall, constructed of concrete with highly conductive covering plates and connecting vertical fins, is investigated. The results demonstrate that, during the charging mode, the amount of energy released from the front surface is significantly reduced. A portion of the saved energy is stored for future discharge, but a large portion is transferred to the back surface and released. A selective front surface reduces the energy released from the front surface, and this energy is stored. By properly selecting the fin spacing, plate-fin thickness, and plate-fin thermal conductivity, the rate and direction of thermal discharge can be controlled. The improved heat transfer capability and added thermal control provide new alternatives for interzonal heat transfer and multizone passive building designs.

28838 (SERI/TP—721-610) **Computer modeling of thermal storage walls.** Connolly, J.M.; Bingham, C.E.; Ortega, J.K.E. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 8p. NTIS, PC A02/MF A01.

The modeling of the three-dimensional heat transfer characteristics of thermal storage walls and the effect of nonuniform irradiation is investigated. Depending on how much of the wall is irradiated, a small error in energy storage is introduced with the one-dimensional, uniform irradiation assumption. The results show that these assumptions, currently used in most passive design codes, are adequate to predict the thermal energy storage characteristics. However, the temperature distribution along the surface of the wall is

much different when the nonuniform irradiation case is considered. The addition of a highly conductive metal cover on the front surface of the wall does not significantly improve the thermal energy storage characteristics of the wall when the wall is partially irradiated. A selective radiation coating reduces front losses and improves the energy storage capacity of the wall 9 to 13%.

28839 (SERI/TR—738-587) **Solar ponds.** Jayadev, T.S.; Edesess, M. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1980. Contract AC02-77CH00178. 44p. NTIS, PC A03/MF A01.

The different types of solar ponds are described, including the nonconvecting salt gradient pond and various saltless pond designs. Then the availability and cost of salts for salt gradient ponds are discussed and costs are compared. A simple computational model is developed to approximate solar pond performance. This model is later used to size solar ponds for district heating and industrial process heat applications. For district heating, ponds are sized to provide space conditioning for a group of homes, in different regions of the United States. Size requirement is on the order of one acre for a group of 25 to 50 homes. An economic analysis is performed of solar ponds used in two industrial process heat applications. The analysis finds that solar ponds are competitive when conventional heat sources are priced at $5 per million Btu and expected to rise in price at a rate of 10% per year. The application of solar ponds to the generation of electricity is also discussed. Total solar pond potential for displacing conventional energy sources is estimated in the range of from one to six quadrillion Btu per year in the near and intermediate future.

GEOTHERMAL ENERGY

28840 (DOE/ET/28476—T1) **Oregon: a guide to geothermal energy development.** Justus, D.; Basescu, N.; Bloomquist, R.G.; Higbee, C.; Simpson, S. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Jan 1980. Contract AS06-77ET28476. 124p. NTIS, PC A06/MF A01.

The following subjects are covered: Oregons' geothermal potential, exploration methods and costs, drilling, utilization methods, economic factors of direct use projects, and legal and institutional setting. (MHR)

28841 (DOE/RA—0051) **Geothermal progress monitor. Progress report No. 3, March-April 1980.** (Department of Energy, Washington, DC (USA). Div. of Geothermal Energy). 1980. 74p. NTIS, PC A04/MF A01.

Progress is reviewed in the following areas: electric uses; direct heat uses; drilling activities; exploration; leases; outreach and technical assistance; feasibility studies and application demonstrations; geothermal loan guarantee program; general activities; R and D activities; legal, institutional, and regulatory activities; environmental activities; and state, local, and private sector activities. Also included are a list of reports and publications and a directory of individuals in the geothermal community. (MHR)

RESOURCE STATUS AND ASSESSMENT

USA

28842 (DOE/ET/27001—7) **Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.** Costain, J.K.; Glover, L. III; Sinha, A.K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Geological Sciences). 1979. Contract AC05-78ET27001. 152p. (VPI-SU—78ET-27001-7). NTIS, PC A08/MF A01.

Separate abstracts were prepared for eight papers. Also included in the report are research objectives, program personnel, and lists of papers published and submitted for publication, abstracts published, and talks given. (MHR)

28843 (NVO—1558-6) **Preliminary definition of the geothermal resources potential of Pennsylvania.** Renner, J.L.; Vaught, T.L. (Gruy Federal, Inc., Arlington, VA (USA)). Jan 1979. Contract ET-78-C-08-1558. 20p. NTIS, PC A02/MF A01.

Pennsylvania has a diverse geology. A small portion of the northeastern corner of the state is covered by Atlantic Coastal Plains sediments. To the northwest metamorphic rocks in the Piedment, Blue Ridge and Reading Prong areas are exposed. Triassic basine cut across portions of the Piedmont. The western portion of the state is underlain by Paleozoic sediments of the folded Appalachians and the Appalachian or Allegheny Basin. Crystalline rocks are limited to the metamorphic and igneous rocks of the Piedmont, Blue Ridge, and Reading Prong and to Triassic diabase intrusives. Potential for geothermal resources in Pennsylvania appear to be limited to small hydrothermal systems associated with deep convection in the folded Appalachians or deep sources in the Appalachian Basin. Heat flow measurements and temperature gradients from oil and gas wells suggest normal continental heat flow in Pennsylvania. Under such conditions temperatures of about 200°C (392°F) are possible near the base of the sedimentary section (about 9 km, 30,000 feet). Warm springs are not as common in Pennsylvania as they are to the south in West Virginia and Virginia. Apparently the structure does not facilitate convective circulation. Geothermal resources in Pennsylvania appear to be restricted to those available in an area of normal temperature gradients.

28844 **Geothermal energy: advanced reservoir developments.** Rowley, J.C. (Los Alamos Scientific Lab., NM); Swanson, R.K.; Westhusing, J.K. *Trans. Am. Nucl. Soc.;* **33**: 2-3(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

28845 (SAND—79-2214) **Numerical solutions for steady thermal convection from a concentrated source in a porous medium.** Hickox, C.E.; Watts, H.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01.

Solutions for the steady, axisymmetric velocity and temperature fields associated with a point source of thermal energy in a fluid-saturated porous medium are obtained numerically through use of similarity transformations. The two cases considered are those of a point source located on the lower, insulated boundary of a semi-infinite region and a point source embedded in an infinite region. Numerical results are presented from which complete descriptions of the velocity and temperature fields can be constructed for Rayleigh numbers ranging from 10^{-3} to 10^{3}.

USA

REFER ALSO TO CITATION(S) 28842, 28861, 28862, 28863

28846 (DOE/ET/27001—7, pp B.2-B.7) **General geology of the east coast with emphasis on potential geothermal energy regions: a detailed summary.** Glover, L. III. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

A review of the geology of the east coast of the USA is presented with emphasis on features having potential geothermal energy resources. The primary features of interest are radiogenic heat sources in the crystalline rocks and insulating properties of sedimentary basin fillings.

28847 (DOE/ET/27001—7, pp B.8-B.10) **Study of the pre-cretaceous basement below the Atlantic Coastal Plain.** Gleason, R. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

Locations and information available for drill holes penetrating basement in South Carolina are presented. It is a summary of continuing work on the Atlantic Coastal Plain thickness and underlying PreCretaceous rocks. (MHR)

28848 **Hydrogeological data of thermal springs and wells in Colorado.** Barrett, J.K.; Pearl, R.H. Denver, CO; Colorado Geological Survey (1976). 128p. $4.50.

Information presented includes: location of all thermal springs and wells, field measurements of temperature, discharge, specific conductance (a measure of the total amount of dissolved solids), pH, chemical and spectrographic analysis of dissolved mineral matter, and associated radioactivity in the thermal waters. An index map showing the location of all thermal springs and wells in Colorado is included. (MHR)

NON-USA

28849 (LBL—10303) **Microfossils from Cerro Prieto geothermal wells, Baja California, Mexico.** Cotton, M.L.; Vonder Haar, S. (University of Southern California, Los Angeles (USA). Dept. of Geological Sciences; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 11p. (CONF-7910166—9). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

To aid in a paleoenvironmental and age reconstruction of the Cerro Prieto reservoir system, 59 samples of well cuttings were

analyzed for microfossils. The cuttings were obtained at depths from 351 to 3495 m in 14 geothermal wells in the Cerro Prieto field, Baja California, Mexico. We found foraminifera in 6 samples, ostracodes in 19 samples, and nannoplankton as coccoliths in 24 samples. Other groups, such as molluscs, insects, fish skeletal parts, and plant material were occasionally present. Detailed interpretations are not possible at this time because of poor preservation of samples. This is primarily due to causes: dissolution by geothermal fluids that reach 350°C, and the extensive mixing of filled Cretaceous forms (reworked from the Colorado Plateau region) with Tertiary species during drilling. Further studies of ostracodes and foraminifera from colder portions of the wells are needed. The abundant and well-preserved ostracodes indicate marine to brackish water environments that correspond, in part, to lagoonal or estuarine facies. The presence of the mid-Tertiary (15-My-old) marine foraminifera, Cassigerinela chipolensis, in wells M-11 and M-38, 350 to 500 m deep, is perplexing. These are not laboratory contaminates and, as yet, have not been found in the drilling mud. If further studies confirm their presence at Cerro Prieto, established ideas about the opening of the Gulf of California and about Pacific Coast mid-Tertiary history will need to be rewritten.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 28842, 29176

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 28861, 29761

28850 (DOE/ET/27001—7, pp A.22-A.32) **Summary of temperature logging of Crisfield, Maryland geothermal test hole.** Dashevsky, S.S.; McClung, W.S. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

Temperature measurements made in the DGT-1 hole at various stages of drilling, hydraulic fracturing and pump testing are reported. The equilibrium temperature at the base of the Atlantic Coastal Plain sediments (1.36 km) is 59°C (137°F). Bottom hole temperature (1.69 km) is 66°C. The gradient in the basement is between 22.6 and 24.8°C/km. The mean thermal conductivity is 3.20 W/m-°C and the heat flow is between 72 to 79 mW/m². Thermal conductivity of the overlying sediments is between 1.72 to 2.30 W/m-°C. With thermal gradients of 29.2 to 36.4°C/km in the Atlantic Coastal Plain, the heat flow is 63 to 78 mW/m². The average heat flow at the DGT-1 site is 72 mW/m². (MHR)

28851 (DOE/ET/27001—7, pp A.83-A.88) **Temperature logs at other locations in the Atlantic Coastal Plain.** Dashevsky, S.S.; McClung, W.S. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

In the continuing effort to acquire temperature data and heat flow from available wells, temperature logs are reported for 3 drill holes: Smith Island, MD, 41°C/km; Parris Island, SC, 33°C/km; and Colonels Island, GA, heat flow = 42 (7) mW/m². In addition DO-1, drilled by this project at Dort, Gates Co., NC, is reported. DO-1 has a thermal gradient of 31°C/km in the Atlantic Coastal Plain and 23°C/km in the granite basement, which is the highest gradient determined to date in a granite in the southeast USA.

28852 (LBL—9545) **Magnetotelluric studies at Cerro Prieto.** Gamble, T.D.; Goubau, W.M.; Goldstein, N.E.; Miracky, R.; Stark, M.; Clarke, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 11p. (CONF-7910166—7). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

Ten magnetotelluric soundings were made near the production zone at Cerro Prieto, bringing to 17 the number of stations occupied in and around the geothermal field during 1978 and 1979. Data were analyzed in the field using a DEC LSI-11 microcomputer installed in a recording truck. The new soundings provide new information on the geometry of the geothermal system. Evidence is found for a narrow resistive zone plunging southeastward, at a shallow angle, from a concealed apex a few hundred meters north of the power plant. This zone comes within about 500 m of the surface and can be traced roughly 5 km to the south. This zone correlates very well with a region of hydrothermal metamorphism, which has been identified by means of detailed studies of cores and cuttings from wells. The three dimensionality of this feature, combined with the influence of the large resistivity contrast between valley sediments and Cucapa Range granites 10 km to the west, makes a rigorous quantitative interpretation impractical. Although such an interpretation awaits further advancements in the techniques of calculating electromagnetic scattering by complex geological structures, the general picture seems clear. A comparison of the subsurface resistivity model with the position of the production zone and with subsurface geology suggests that the heat source lies at depth, roughly 4 km south-southeast of the present power plant. North of the power plant a two-dimensional interpretation of the magnetotelluric data is possible. A good fit between observed and calculated parameters is obtained for a subsurface model that is consistent with the model derived from dipole-dipole dc resistivity measurements.

28853 (LBL—9551) **Precision gravity studies at Cerro Prieto: the second year.** Grannell, R.B.; Tarman, D.W.; Clover, R.C.; Leggewie, R.M.; Aronstam, P.S.; Kroll, R.C.; Eppink, J. (California State Univ., Long Beach (USA); California State Polytechnic Univ., Pomona (USA)). Feb 1980. Contract W-7405-ENG-48. 5p. (CONF-7910166—5). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

Precision gravity measurements were initiated at Cerro Prieto in 1978. Interpretation of the first annual repetition of the measurements is presented. Field procedures, data reduction, and data interpretation are reviewed briefly. (MHR)

28854 (NMEI—48) **Electrical exploration for geothermal resources near San Diego Mountain, New Mexico. Final report, July 1, 1978-September 30, 1979.** Young, C.T. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Sep 1979. 25p. New Mexico State Univ., New Mexico Energy Inst., Las Cruces.

The area near San Diego Mountain, New Mexico is considered to have geothermal potential because of nearby recent volcanoes and travertine deposits, high geochemical temperatures, high borehole temperatures and gradients and the Known Geothermal Resource Area of Radium Springs. To further evaluate the geothermal potential of this area, electrical resistivity reconnaissance has been conducted to search for low resistivity zones that might be hot rock or hot water. Schlumberger profiling and telluric current measurements made near San Diego Mountain have found low resistivity regions immediately north and east of the mountain. These low resistivities may mark high temperature or saline water associated with the high thermal gradients of about 200°C/km, measured in drill holes on San Diego Mountain. Other low resistivity regions were found on the north side of the Sierra de las Uvas and the Mesilla Basin to the southwest. This latter region is probably warm saline water that extends to known warm wells and low resistivities near Kilbourne Hole.

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 28848

28855 (EGG-PHYS—5169) **Radium and uranium determination in samples of Utah Roses geothermal water.** Willis, C.P. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1980. Contract AC07-76ID01570. 11p. NTIS, PC A02/MF A01.

The method of direct alpha counting on separated elements was used for the analysis of geothermal water. The radium and thorium were separated from uranium by chemical means and both were collected for gross alpha counting on barium sulfate. Results are presented and discussed. The procedure is described in the appendix. (MHR)

28856 (LBL—10166(Rev.)) **Chemistry of silica in Cerro Prieto brines.** Weres, O.; Tsao, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 19p. (CONF-7910166—6(Rev.)). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

The precipitation of amorphous silica from synthetic geothermal brines that resemble the flashed brine at Cerro Prieto was studied. It was found that part of the dissolved silica quickly polymerizes to form suspended colloidal silica. The colloidal silica flocculates and settles slowly at unmodified brine pH values near 7.35. Raising the pH of the brine to about 7.8 by adding base and stirring for a few minutes causes rapid and complete flocculation and settling. These results have been confirmed in the field using actual Cerro Prieto brine. Several commercially available flocculating agents were also tested. Both in the laboratory and in the field, it was found quaternary amines to be effective with some brine compositions but not with others. Polyacrylamides do not work at all. These results suggest the following simple preinjection brine treatment process: age the brine for 10 to 20 minutes in a covered holding tank, add 20 to 30 ppm lime (CaO), stir for 5 minutes, and separate the flocculated silica from the brine using a conventional clarifier. The brine coming out of such a process will be almost completely free of suspended solids. The pilot plant tests needed to reduce this conceptual process to practice are discussed. In a separate study, the rate of

deposition of silica scale from synthetic brines was researched. It was found that a modest decrease in pH could significantly reduce the scaling rate at a reasonable cost.

28857 (PNL—3412) **Field evaluation of sampling methods for pressurized geothermal liquids, gases, and suspended solids.** Shannon, D.W.; Cole, M.W.; DeMonia, D.D.; Divine, J.R.; Jensen, G.A.; Kindle, C.H.; Koski, O.H.; Smith, R.P.; Woodruff, E.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract AC06-76RL01830. 173p. NTIS, PC A08/MF A01.

Many different sampling methods were tested and compared for collecting samples for measurement of brine chemistry, gases, and suspended solids from pressurized geothermal systems. The tests were conducted on the 6-2 wellhead and a test loop at the Department of Energy's Geothermal Test Facility at East Mesa, California. The recommended methods for single-phase liquid or single-phase steam (with gases) are presented, together with detailed procedures. The results of testing methods for sampling two phase liquid-steam systems showed significant errors can result. It was recommended that two-phase flowing wells be directed to a full flow separator and the single-phase liquid and single-phase steam sampled separately using the recommended methods.

28858 (DOE/EV/70048—2) **Trace metal characterization and speciation in geothermal effluent by multiple scanning anodic stripping voltammetry and atomic absorpotion analysis. Annual progress report.** Kowalski, B.R. (Washington Univ., Seattle (USA). Dept. of Chemistry). [nd]. Contract AT06-76EV70048. 9p. NTIS, PC A02/MF A01.

Only the actual application of the ultratrace metal analysis methods to samples taken from geothermal sites in Washington and Oregon is covered. The in-field sampling equipment constructed for the studies, procedures developed or adapted, and the results obtained on representative samples taken from geothermal sites are described. (MHR)

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 28851

28859 (DOE/ET/27001—7, pp A.5-A.6) **Description of basement rocks from Crisfield, deep geothermal test well.** Gleason, R.J. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

The basement rock encountered between the depths of 1.36 - 1.69 km is described. It is a fine-grained, massive to laminated volcaniclastic rock with a greenschist grade metamorphic assemblage of chlorite + muscovite + epidote + albite + quartz. The hole was drilled on the edge of the Chesapeake gravity low. (MHR)

28860 (DOE/ET/27001—7, pp A.7-A.21) **Coastal Plain stratigraphy at DGT-1, Crisfield, Maryland.** Svetlichny, M.; Lambiase, J.J. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

The stratigraphy, lithologic descriptions, gamma log, and electric log of the Atlantic Coastal Plain sediments in the DGT-1 well are presented. (MHR)

28861 (DOE/ET/27001—7, pp A.33-A.82) **Comparison of geothermal gradients and gamma logs in shallow holes (300 m) in the Atlantic Coastal Plain.** McClung, W.; Dashevsky, S.; Thoreson, B. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

It is found that units with high gamma-ray readings tend to be clay-rich rocks with low thermal conductivities and higher geothermal gradients. Deviations are encountered in sands with abundant heavy mineral concentrations, glauconite-bearing rocks or water-saturated rocks. (MHR)

28862 (DOE/ET/27001—7, pp B.11-B.19) **Petrography of the granitic basement (portion of the) DO-1 drill hole in the North Carolina Coastal Plain.** Becker, S.W. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

The drilling program is constantly obtaining core of crystalline rock beneath the sediments of the Atlantic Coastal Plain, an area about which very little is known. The 287 feet of basement core obtained from the DO-1 drill hole near Dort, Gates Co., NC is described. The rock is a coarse-grained, amphibole-biotite granite which closely resembles the Petersburg, VA granite which is exposed 75 km to the northeast. (MHR)

28863 (DOE/ET/27001—7, pp B.20-B.46) **Field relations and petrology of the postmetamorphic, coarse-grained granites and associated rocks in the Southern Appalachian Piedmont.** Speer, J.A.; Becker, S.W.; Farrar, S.S. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1-September 30, 1979.

Four years of work on the field relations, petrography and mineralogy of the post-metamorphic, coarse-grained granites and associated rocks in the southern Appalachian Piedmont are summarized. The comparative data base for: (1) better understanding the granites encountered in basement cores recovered from beneath the Atlantic Coastal Plain; and (2) improving targeting procedures for locating concealed radiogenic granites in the basement is provided. (MHR)

LEGAL AND INSTITUTIONAL ASPECTS

28864 **Drilling and operating geothermal wells in California.** Sacramento, CA; California Division of Oil and Gas (1979). 16p. (NP—24447; PR—7S). State of California, Documents Section, P.O. Box 1015, North Highlands, CA.

The following procedural points for geothermal well drilling and operation are presented: geothermal operators, definitions, geothermal unit, agent, notice of intention, fees, report on proposed operations, bonds, well name and number, well and property sale on transfer, well records, and other agencies. (MHR)

28865 (DOE/ID/12013—2) **Geothermal institutional handbook for the State of Wyoming: a user's guide of agencies regulations, permits and aids for geothermal development.** Aspinwall, C.; Caplan, J.; James, R.; Marcotte, K. (Wyoming Geothermal Commercialization Office, Laramie (USA)). May 1980. Contract FC07-79ID12013. 48p. NTIS, PC A03/MF A01.

The agencies involved in geothermal development are listed and individually described. A summary of existing geothermal resource laws and their statute numbers are given followed by a discussion on the problems associated with them. The local agencies and their regulations of geothermal development are discussed. The local, state, and federal agencies directly involved in geothermal development and their permitting requirements are tabulated. Some step-by-step instructions for determining what permits are necessary for developing a specific geothermal resource are given. A list of selected references and a list of additional resources for geothermal information and referral are included. (MHR)

28866 (DOE/ID/12015—2) **Arizona geothermal institutional handbook: Arizona geothermal commercialization planning team, January 1-December 31, 1979.** Malysa, L. (Arizona Solar Energy Research Commission, Phoenix (USA)). May 1980. Contract AC07-76ID01570. 75p. NTIS, PC A04/MF A01.

The purpose of this handbook is to assist in understanding the various procedures and requirements necessary for the development of geothermal energy in the State of Arizona. It contains the names of key persons and agencies who are directly or indirectly involved in the institutional process. A detailed assessment of all agencies and the role they play in geothermal energy development is provided. The handbook is divided into four sections: State and Local rules and regulations, the Federal rules and regulations, references, and a technical bibliography. (MHR)

28867 (EGG-GTH—5007) **Geothermal development in southwest Idaho: the socioeconomic data base.** Spencer,S.G.; Russell, B.F. (eds.). (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1979. Contract AC07-76ID01570. 277p. NTIS, PC A13/MF A01.

This report inventories, analyzes, and appraises the existing socioeconomic data base for the ten counties in southwest Idaho that would be impacted by any significant geothermal development. The inventory describes key sociological demographic, and economic characteristics, and presents spatial boundaries, housing data, and projections of population and economic activity for the counties. The inventory identifies the significant gaps in the existing data base and makes recommendations for future research.

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 28867

28868 (COO—27242-2) **Effect of proposed Federal tax credits and forgivable loans on geothermal electric power development: hot line report.** Cassel, T.A.V. (Technecon Analytic Research, Inc., Philadelphia, PA (USA)). Nov 1979. Contract AC02-79ET27242. 10p. NTIS, PC A02/MF A01.

The likely impacts of two proposed federal incentives for accelerating the development of geothermal resources for electric

power production are evaluated. The incentives are: an additional 20% investment tax credit applicable to both well field capital and power plant capital; and a federal loan for 50% of the cost of exploration and confirmation wells which is entirely forgivable if the wells prove unsuccessful. The evaluations were performed by the use of DOE's geothermal investment decision model (TCN2000), which is presently capable of estimating the probability of progressive levels of development at ten Known Geothermal Resource Areas (KGRA's) in California and Utah.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 28886

28869 (LA—8398-MS) **Preliminary study of the potential environmental concerns associated with surface waters and geothermal development of the Valles Caldera.** Langhorst, G.J. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

A preliminary evaluation is presented of possible and probable problems that may be associated with hydrothermal development of the Valles Caldera Known Geothermal Resource Area (KGRA), with specific reference to surface waters. Because of the history of geothermal development and its associated environmental impacts, this preliminary evaluation indicates the Valles Caldera KGRA will be subject to these concerns. Although the exact nature and size of any problem that may occur is not predictable, the baseline data accumulated so far have delineated existing conditions in the streams of the Valles Caldera KGRA. Continued monitoring will be necessary with the development of geothermal resources. Further studies are also needed to establish guidelines for geothermal effluents and emissions.

28870 (LBL—7007) **Modeling subsidence due to geothermal fluid production.** Lippmann, M.J.; Narasimhan, T.N.; Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1977. Contract W-7405-ENG-48. 28p. (CONF-771027—3). NTIS, PC A03/MF A01.

From American Society of Civil Engineers annual convention; San Francisco, CA, USA (17 Oct 1977).

Currently, liquid dominated geothermal systems hold the maximum promise for exploiting geothermal energy in the United States. The principal characteristic of such systems is that most of the heat is transferred by flowing water, which also controls subsurface fluid pressures and stress changes. The reduction in pore pressures brought about by geothermal fluid extraction is potentially capable of causing appreciable deformation of the reservoir rocks leading to displacements at the land surface. In order to foresee the pattern and magnitude of potential ground displacements in and around producing liquid dominated geothermal fields, a numerical model has been developed. Conceptually, the simulator combines conductive and convective heat transfer in a general three dimensional heterogeneous porous medium with a one-dimensional deformation of the reservoir rocks. The capabilities of the model and its potential applicability to field cases are illustrated with examples considering the effects of temperature and pressure dependent properties, material heterogeneities and previous stress history.

28871 (LBL—9563) **Theoretical studies of Cerro Prieto brines chemical equilibria.** Iglesias, E.R.; Weres, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 8p. (CONF-7910166—1). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

A chemical equilibrium model is used, implemented in a compact FORTRAN package called HITEQ, to investigate possible mineral deposition related to prereinjection treatment of Cerro Prieto brines for silica removal. Large saturation ratios of the treated brines with respect to several minerals are indicated by these computations. As a remedy, an inexpensive CO_2 removal scheme aimed at inhibiting carbonate mineral precipitation is proposed. This scheme is quantitatively discussed with the aid of HITEQ. It is concluded that the proposed treatment is both technically and economically feasible.

28872 (LBL—10794) **Simulation of geothermal subsidence.** Miller, I.; Dershowitz, W.; Jones, K.; Myer, L.; Roman, K.; Schauer, M. (Golder Associates, Inc., Kirkland, WA (USA)). Mar 1980. Contract W-7405-ENG-48. 170p. (GSRMP—6). NTIS, PC A08/MF A01.

The results of an assessment of existing mathematical models for subsidence simulation and prediction are summarized. The following subjects are discussed: the prediction process, physical processes of geothermal subsidence, computational models for reservoir flow, computational models for deformation, proficiency assessment, and real and idealized case studies. (MHR)

GEOTHERMAL POWER PLANTS

28873 **Economics of electric power generation using geothermal resources.** Hankin, J.W. (Bechtel National, Inc., San Francisco, CA); Butler, D.R.; Bloomster, C.H. *Trans. Am. Nucl. Soc.;* **33**: 3(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

POWER PLANT SYSTEMS AND COMPONENTS

28874 (CONF-800379—1) **Discussion of enhancement in condensers.** Michel, J.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From Workshop on modern developments in marine condensers; Monterey, CA, USA (26 Mar 1980).

A brief discussion of Professor Ralph L. Webb's paper, The Use of Enhanced Surface Geometries in Condensers, is given with emphasis on the importance of overall cost optimization in the application of heat transfer enhancement. A review of ORNL condensation experiments with enhanced surfaces is presented. The work has centered on optimizing the design variables associated with fluted surfaces on vertical tubes and comparing the tube performance with available enhanced tubes either for vertical or horizontal operation. Data with seven fluids including a hydrocarbon, fluorocarbons, and ammonia condensing on up to 30 different tubes have been obtained. The primary conclusion from this work is that fluted tubes can provide an enhancement in condensation coefficient of a factor of 6 over smooth vertical tubes and a factor of 2 over enhanced commercial tubes either operating vertically or horizontally. These data, together with field test data, have formed the basis for designing a prototype condenser for the 500 kWe East Mesa, California, direct-contact geothermal demonstration plant.

28875 (SAN—1137-14) **Geothermal Loop Experimental Facility. Quarterly report, January-March, 1979.** Anastas, G.; Bischoff, W.S.; Bishop, H.K. (San Diego Gas and Electric Co., CA (USA)). Apr 1979. Contract EY-76-C-03-1137. 222p. NTIS, PC A10/MF A01.

The general operations and accomplishments of the Geothermal Loop Experimental Facility during the period from January 1, 1979 through March 31, 1979 are summarized. The construction and installation of a reactor clarifier/media filter system to treat the effluent brine continued. Startup is expected during the next reporting period. Operations of the facility evaluated the two stage flash cycle characteristics of brines from the second production well (Woolsey No. 1). The results were similar to the characteristics of the first production well (Magmamax No. 1) that were reported previously. The 1979 test program has been initiated and preliminary results documented.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 28864

28876 (BNL—51183) **Hydrothermal cements for use in the completion of geothermal wells. Final report.** (Southwest Research Inst., San Antonio, TX (USA)). Sep 1979. Contract AC02-76CH00016. 60p. NTIS, PC A04/MF A01.

A research program to develop an improved cement for use in high-temperature geothermal wells was carried out. The work involved in the selection and evaluation of an aluminum hydroxide-cured cement from the SwRI family of hydrothermal cements for this use are described. The physical testing program is described; the topics discussed include placement ability, compressive and bond strengths, permeability to water, compatibility to drilling muds, corrosion properties, and thermal properties.

28877 (DOE/ET/28460—1(Vol.1)) **Investigation and evaluation of geopressured-geothermal wells. Fairfax Foster Sutter No. 2 well, St. Mary Parish, Louisiana. Volume I. Completion and testing. Final report.** Willits, M.H.; McCoy, R.L.; Dobson, R.J.; Hartsock, J.H. (Gruy Federal, Inc., Houston, TX (USA)). Dec 1979. Contract AC08-77ET28460. 128p. NTIS, PC A07/MF A01.

The Fairfax Foster Sutter No. 2 well, located in the East Franklin area of St. Mary Parish, Louisiana, is the first successful test of a geopressured-geothermal aquifer under the Well-of-Opportunity program. The section tested was the MA-6 sand of lower Miocene age which has produced large quantities of gas from the adjacent but structurally separated Garden City field. In the subject well the observed temperature was 270°F (132°C) and the measured gradient

was 0.77 psi/ft. The gross sand thickness was 270 feet, the net sand thickness 190 feet, and the tested interval 58 net feet. The temperatures and pressures encountered approached the limits of the surface-recording bottomhole pressure gauge and particularly the single-conductor cables on which the gauges were run. The objectives of the tests were all accomplished, and data were obtained which will contribute to the overall assessment of the geopressured-geothermal resource of the Upper Gulf of Mexico basin. In general, the gas solubility (22.8 scf/bbl) was as expected for the temperature, pressure, and salinity of the brine. The produced water was more saline than expected (160,000 mg/l). The high concentrations of dissolved solids, coupled with the evolution of CO_2 from these waters during production, created a scaling problem in the tubular goods and surface equipment that will have to be addressed in future tests.

28878 (NVO—1528-4) **Investigation and evaluation of geopressured-geothermal wells. Final report.** Dobson, R.J.; Hartsock, J.H.; Willits, M.H. (Gruy Federal, Inc., Houston, TX (USA)). Jan 1979. Contract EG-77-C-08-1528. 95p. NTIS, PC A05/MF A01.

This well was approved for reentry and test operations after consideration of a number of reentry prospects in Cameron Parish. This was a marsh location that required 2.3 miles of board road and replacement of two bridges. Road work was commenced on June 19, 1978, and site preparation was completed on October 25. The drilling rig moved on location on November 2. This rig was released on December 16. Reentry operations were completely unsuccessful because of failure to effect a tieback of the 7" casing. The plugging and abandonment records filed with the Louisiana Department of Conservtion indicated that the top of the 7" casing was at or near the base of the 10-3/4" casing when the well was plugged. These records did not specify that the 7" casing had been dynamited one or more times during the recovery operation. Numerous attempts were made to locate and condition the 7" casing for tying back to the surface. All these were unsuccessful. The top of the 7" casing was never clearly located, or if located was subsequently lost, and therefore it was not possible to cut and recover the damaged section in order to effect a tieback. The total cost of the attempted reentry was approximately $1,925,000. Of this amount, some $444,000 was spent on road and site preparation and disposal well. This expenditure can be salvaged in the event a decision is made to redrill the well.

28879 (SAND—80-0703) **Geothermal drilling and completion technology development program. Quarterly progress report, January-March 1980.** Varnado, S.G. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Apr 1980. Contract AC04-76DP00789. 222p. NTIS, PC A10/MF A01.

The progress, status, and results of ongoing Research and Development (R and D) within the Geothermal Drilling and Completion Technology Development Program are described. The program emphasizes the development of geothermal drilling hardware, drilling fluids, completion technology, and lost circulation control methods. Advanced drilling systems are also under development. The goals of the program are to develop the technology required to reduce well costs by 25% by 1983 and by 50% by 1987.

28880 (SAND—80-1350C) **Geothermal well cost sensitivity analysis: current status.** Carson, C.C.; Lin, Y.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-800920—11). NTIS, PC A02/MF A01.

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The geothermal well-cost model developed by Sandia National Laboratories is being used to analyze the sensitivity of well costs to improvements in geothermal drilling technology. Three interim results from this modeling effort are discussed. The sensitivity of well costs to bit parameters, rig parameters, and material costs; an analysis of the cost reduction potential of an advanced bit; and a consideration of breakeven costs for new cementing technology. All three results illustrate that the well-cost savings arising from any new technology will be highly site-dependent but that in specific wells the advances considered can result in significant cost reductions.

28881 (SAND—80-7031C) **Considerations in the use of water jets to enlarge deep submerged cavities.** Summers, D.A.; Sebastian, Z. (Missouri Univ., Rolla (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-800651—1). NTIS, PC A02/MF A01.

From 5. symposium on water jet cutting; Hanover, F.R. Germany (2 Jun 1980).

In order to facilitate use of reinjection wells, and to lower their cost, it has been proposed that a single well be reamed from 22-1/2 cm to 2 m diameter over an increment of 70 m at a depth of 2000 m. In this manner a single well would be capable of coping with flow rates which currently necessitate a dozen wells being emplaced. The problems encountered in using high pressure water jets for this reaming operation are described. Limiting parameters on the use of high pressure water jets and their operating diameters are identified. The considerable advantages to the use of long chain polymers in such a hostile environment are also delineated.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 28856, 28875

28882 (LBL—10673) **Deposition of $CaCO_3$ in porous materials by flashing geothermal fluid.** Michels, D.E. (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Apr 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

Deposition of $CaCO_3$ from natural geothermal fluid was studied by using porous substrates made from several granular materials. These experiments aimed to explore connections between the process of steam flash from superheated CO_2-charged water and the consequent changes in the carbonate chemical equilibria. The substrates were characterized pre- and post-experiment. Flow rates and compositions of input and output fluids were determined. The resultant $CaCO_3$ deposits were examined from several points of view. (MHR)

28883 (PNL—3073) **Analysis of a scaling rate meter for geothermal systems.** Kreid, D.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 54p. NTIS, PC A04/MF A01.

A research project was conducted to investigate an experimental technique for measuring the rate of formation of mineral scale and corrosion in geothermal systems. A literature review was performed first to identify and evaluate available techniques for measuring scale in heat transfer equipment. As a result of these evaluations, a conceptual design was proposed for a geothermal Scaling Rate Meter (SRM) that would combine features of certain techniques used (or proposed for use) in other applications. An analysis was performed to predict the steady-state performance and expected experimental uncertainty of the proposed SRM. Sample computations were then performed to illustrate the system performance for conditions typical of a geothermal scaling application. Based on these results, recommendations are made regarding prototype SRM construction and testing.

28884 (SAN—1308-2) **Geothermal elastometric materials (GEM) program. Final report.** Hirasuna, A.R.; Bilyeu, G.D.; Davis, D.L.; Sedwick, R.A.; Stephens, C.A.; Veal, G.R. (L'Garde, Inc., Newport Beach, CA (USA)). Jul 1979. Contract EG-77-C-03-1308. 258p. NTIS, PC A12/MF A01.

The primary program objective, to develop a geothermal packer elastomer to withstand 260°C (500°F) geothermal brine with 300 ppM H_2S, 1000 ppM CO_2, 25,000 ppM NaCl in aqueous solution for 24 hours, was successfully accomplished. In fact the requirement for one elastomer was exceeded, compounds from four elastomeric polymer systems were successfully developed to meet the GEM requirements providing good flexibility for various situations. Several secondary spin-offs also resulted. The compounds were developed for the casing packer seal application and it was demonstrated that these compounds are directly applicable to the static O-ring and other elastomer applications in similarly unusually severe environments. There is also indication based on drill bits seal tests that the basic compounds will be adaptable to high-temperature dynamic seal applications. Another secondary spin-off is a different conceptual approach to the thermal casing packer problem. This approach concentrates on minimizing the stresses subjected on the sealing element. Since it is fundamentally different, it has a good chance of advancing thermal packer capability in a revolutionary manner as opposed to an evolutionary manner.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

28885 (DOE/ET/28460—1(Vol.2)) **Investigation and evaluation of geopressured-geothermal wells: Fairfax Foster Sutter No. 2 well, St. Mary Parish, Louisiana. Volume II. Well test data. Final report.** Willits, M.H.; McCoy, R.L.; Dobson, R.J.; Hartsock, J.H. (Gruy Federal, Inc., Houston, TX (USA)). Dec 1979. Contract AC08-77ET28460. 188p. NTIS, PC A09/MF A01.

The following data tables are included: pressure buildup, pressure survey, geothermal field test, analyses of reservoir brine, recombination analysis, analyses of separator gas, analyses of scale samples, H_2S in separator gas, and analysis of reservoir data. (MHR)

28886 (LBL—9589) **Simulation of reinjection at Cerro Prieto using an idealized two-reservoir model.** Tsang, C.F.; Mangold, D.C.; Lippmann, M.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 12p. (CONF-7910166—2). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

An idealized two-reservoir model was introduced to explore some of the effects of reinjection in a geothermal field. For both the single-well model and the doublet model, the results indicate that

reservoir pressures will be adequately maintained even when an intervening layer of low permeability is present. The same intervening layer may nevertheless be an effective barrier to the movement of cold fronts, due to the effect of gravity and viscosity on the flow of denser colder waters. This shows promise for developing reinjection strategies that can be tested on more detailed simulation models for specific sites such as th Cerro Prieto field.

28887 (LBL—9591) **High-temperature geothermal reservoir engineering.** Schroeder, R.C.; Benson, S.; Goranson, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 9p. (CONF-7910166—8). NTIS, PC A02/MF A01.

From 2. symposium on the Cerro Prieto Geothermal Field; Baja California, Mexico (17 Oct 1979).

A review of high-temperature geothermal reservoir engineering is presented. High-temperature downhole conditions encountered during field activities are reviewed with data from Cerro Prieto as the primary example. The types of measurements required for estimation of formation parameter values and how they depend on other geoscience data are reviewed. The analysis techniques that are currently used to evaluate field data are discussed and their limitations, applicability, and associated difficulties are described using data from Cerro Prieto as an example. Downhole tools that are needed for high-temperature measurements are discussed with a review of the current state of the art. The use of measured data in reservoir engineering simulation calculations is summarized, and different numerical models are reviewed. Data from Cerro Prieto are used as an example to show how reserves and reservoir depletion calculations can be used to aid the field developer in choosing operational field strategies.

28888 (NVO—1528-6) **Investigation and evaluation of geopressured-geothermal wells. Package No. 1 of wells-of-opportunity candidates.** (Gruy Federal, Inc., Houston, TX (USA)). Feb 1978. Contract EG-77-C-07-1528. 64p. NTIS, PC A04/MF A01.

This group of wells-of-opportunity (WOO) consists of six candidates; one in Texas and five in Cameron Parish, Louisiana. Of the latter, two of three candidates are considered to be mutually exclusive in that each exhibits good potential for testing geopressured-geothermal aquifers which are indicated to be of sufficient volume for purposes of a 30-day test. A final selection of one location may be made from these three wells, assuming all pass screening criteria, based on estimated cost of the test and the negotiation of a satisfactory agreement with the owners of the surface and/or the minerals. Information is presented on the six candidates and a short write-up is included on one other well. (MHR)

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

28889 (LA—8354-MS) **Preliminary evaluation of the second hot dry rock geothermal energy reservoir: results of phase 1, run segment 4.** Murphy, H.D.; Aamodt, R.L.; Albright, J.N. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 92p. NTIS, PC A05/MF A01.

Results of the preliminary assessment of the second hot dry rock reservoir at the Fenton Hill field site are presented. This second reservoir was created by fracturing a deeper interval of granite rock located at a depth of 2.93 km (9620 ft) in the same wellbore pair used in the creation of the first reservoir; no additional redrilling was required. The new fracture system has a vertical extent of at least 320 m (1050 ft), suggesting that the combined heat-transfer area of the old and new fracture systems is 11 times that of the old system. The virgin rock temperature at the bottom of the deeper interval was 197°C (386°F). Water at a flow rate of 6 l/s (100 gpm) was circulated through the reservoir for a period of 23 days. Downhole measurements of the water temperature at the reservoir outlet, as well as temperatures inferred from geothermometry, showed that the thermal drawdown of the reservoir was negligible and preliminary estimates indicate that the minimum effective heat-transfer area of the new reservoir is 45,000 m^2 (480,000 ft^2), which is six times larger than the first reservoir. The following are presented: operational plan, reservoir geometry and flow paths, flow impedance, geochemistry, heat extraction, dye tracer flow distribution studies, and seismicity. (MHR)

28890 (LA-UR—80-1465) **Hot dry rock pilot project.** Smith, M.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800704—2). NTIS, PC A02/MF A01.

From NATO/CCMS meeting on pilot studies; Paris, France (15 Jul 1980).

The history of the hot-dry-rock project and the NATO-CCMS interest in it is reviewed. (MHR)

28891 (LA-UR—80-1713) **Explosive stimulation of a geothermal well at the Geysers.** Hanold, R.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-800242—1). NTIS, PC A02/MF A01.

From Symposium on geothermal well stimulation; San Francisco, CA, USA (7 Feb 1980).

The use of an explosive in a vapor-dominated reservoir is discussed. The explosive and the present experimental plan are described. The explosive is HITEX II and some of its properties are listed. (MHR)

28892 (LA-UR—80-1714) **Geothermal well stimulation program: opening remarks.** Hanold, R.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800242—2). NTIS, PC A02/MF A01.

From Symposium on geothermal well stimulation; San Francisco, CA, USA (7 Feb 1980).

The history of well stimulation and the development of the geothermal well stimulation program are reviewed briefly. (MHR)

DIRECT ENERGY UTILIZATION

28893 (BNL—27546) **Planning analyses for geothermal district heating.** Tessmer, R.G. Jr.; Karkheck, J. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1979. Contract AC02-76CH00016. 15p. (CONF-791204—36). NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Methodology and data bases are described which can provide a comprehensive planning assessment of the potential for geothermal district heating in any US market. This economic systems model encompasses life-cycle costing over a period of rising competitive fuel prices, it addresses the expansion and financing of a district system over time, and it includes an overall optimization of system design. The elemental area for all analyses is the census tract, for which published data allow estimation of residential and commercial heating demands, building retrofit requirements, and competitive fuel consumption and cost. A system type design, an appropriate hot water district piping system, and costing of heat supply is performed for groups of contiguous tracts in any urban market. Groups are aggregated, in decreasing benefit to cost order, to achieve optimal systems. A specific application for Salt Lake City, Utah, is also described.

28894 (CONF-800806—7) **Heat pumps in low temperature applications.** Keller, J.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

Methods of efficiency using the lower temperature geothermal resources for space conditioning are presented. Water-to-air and water-to-water heat pumps are available today for use with domestic or thermally marginal geothermal water in the 50 to 90°F (10 to 32°C) range. Custom-designed heat pumps can be used with source temperatures above 90°F (32°C) to bridge the gap between direct and indirect utilization concepts. Recent developments as they apply to geothermal resource utilization are presented. This paper concentrates upon a new and novel diaphragm type heat pump for use with source temperatures as low as 40°C. (MHR)

28895 **Geothermal energy direct use: a status review.** Kunze, J.F. (Forsgren, Perkins and Associates, Rexburg, ID); Sherwood, P.B.; Schultz, R.J. *Trans. Am. Nucl. Soc.;* 33: 3-4(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

GEOTHERMAL DATA AND THEORY

REFER ALSO TO CITATION(S) 28855

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 29764

28896 (SAND—80-0641) **Development of high temperature viscosity measurement techniques.** Wemple, R.P.; Hammetter, W.F.; Greenholt, C.J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

Viscosity measurements with magmatic rock at high temperatures and occasionally at elevated pressures are nontrivial problems. The conception, development, and testing of: (1) an electromagnetic viscometer and (2) an x-ray technique are reported. Both methods employ a falling metallic sphere in the melt and provide real-time data. Initial testing of the electromagnetic viscometer was performed

at one bar and from 700 to 1300°C. Follow-on experiments with this viscometer were carried out at 1 bar and 0.466 Kbar (6.8 Kpsi) argon up to 1250°C at the Sandia Magma Energy Research Test Facility. The x-ray method was tested entirely at one bar and up to 1325°C. A simultaneous test series with both methods was performed at one bar. Various calibration glasses and basalts were used to evaluate the methods. Correlation of the two methods with each other and with reference data was within acceptable limits.

TIDAL POWER PLANTS

REFER ALSO TO CITATION(S) 29175

WAVE ENERGY CONVERTERS

REFER ALSO TO CITATION(S) 28677, 29175

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 29175

28897 (UCRL—84503) **Application of a photodiode-array optical turbulence sensor to wind studies in complex terrain.** Porch, W.M.; Green, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 18p. (CONF-800480—3). NTIS, PC A02/MF A01.

From ASCOT program planning meeting; Gettysburg, PA, USA (15 Apr 1980).

A digital photodiode-array optical turbulence sensor was used to gather data simultaneously with analog optical anemometer measurements during the July 1979 ASCOT experiment. This system provided useful information regarding the uniformity of optical turbulence used by the optical anemometer to derive cross-path wind speeds. Wind speeds derived from digital analysis of the photodiode-array intensities also provided an independent measure of the cross-path wind speed. Close agreement was found between these two measures of the wind.

REGULATIONS

REFER ALSO TO CITATION(S) 28582

ECONOMICS

28898 (DOE/DP/03533—T2) **Financial problems facing the manufacturers of small wind energy conversion systems. Final report.** Bolle, T.G. (United Technologies Research Center, East Hartford, CT (USA)). Nov 1979. Contract AC04-76DP03533. 66p. NTIS, PC A04/MF A01.

The financial barriers faced by the manufacturers of small wind energy conversion systems (SWECS) are assessed and found to be similar to those faced by other start up businesses. However, these problems are found to be aggravated by the high expectations for accelerated SWECS industry growth in the face of moderate government support and lack of investment capital. The underlying conditions of limited SWECS entrepreneur business experience, the highly competitive venture capital market, the inability of existing financial institutions to aid infant busineses and public unawareness of SWECS are reviewed. Specific manufacturer-oriented recommendations and federal, state and regulatory policy-oriented recommendations are made. In addition, the dynamics of the SWECS commercialization process are assessed and the variety of financial institutions playing a role in this process is detailed. Issues related to inflation, tax policy, regulation and federal R and D procurement policies are analyzed.

28899 (SERI/TR—8003-1) **Preliminary technical and economic evaluation of vortex extraction devices.** Kornreich, T.R.; Kottler, R.J. Jr.; Jennings, D.M. (JBF Scientific Corp., Arlington, VA (USA)). Apr 1980. Contract AC02-77CH00178. 90p. NTIS, PC A05/MF A01.

Two innovative vortex extraction devices - the Tornado Wind Energy System (TWES) and the Vortex Augmentor Concept (VAC) - are critically evaluated to provide a preliminary assessment of their technical and economic viability as compared to conventional horizontal axis wind energy systems. This assessment was carried out over a wide range of power output levels and augmentation ratios appropriate to each of the concepts.

28900 (SERI/TR—8003-2) **Preliminary technical and economic evaluation of vortex extraction devices. Summary report.** Kornreich, T.R.; Kottler, R.J. Jr.; Jennings, D.M. (JBF Scientific Corp., Arlington, VA (USA)). Apr 1980. Contract AC02-77CH00178. 29p. NTIS, PC A03/MF A01.

The rotor subsystem represents one of the major cost drivers in conventional wind energy systems. Despite the fact that the two vortex extraction systems evaluated have the potential for substantially reducing rotor costs, these cost savings are more than offset by the additional costs required for the augmentation devices. Based on a preliminary analysis of the presently envisioned conceptual designs of the Tornado Wind Energy System and the Vortex Augmentor System, it does not appear that either system could achieve economic parity with conventional horizontal axis wind systems even if all of the technical uncertainties surrounding these innovative concepts are favorably resolved.

ENVIRONMENTAL ASPECTS

28901 (RFP—3072) **Wind energy conversion, is it environmentally acceptable.** Cingo, R.P. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03538. 10p. (CONF-800517—6). NTIS, PC A02/MF A01.

From 26. annual technical meeting of the Institute for Environmental Sciences; Philadelphia, PA, USA (11 May 1980).

The widespread implementation of wind energy conversion systems presents a number of environmental concerns that must be assessed and, if found to be significant, must be solved before commercialization of these systems can be accomplished. This paper provides an overview of the current state of knowledge relating to the assessment of the environmental impacts of wind energy conversion systems. The text identifies five generic areas that have been investigated and summarizes the conclusion of studies conducted in each area.

WIND ENERGY ENGINEERING

APPLICATIONS

28902 (DOE/DP/03533—T3) **Investigation of the feasibility of using wind power for space heating in colder climates. Annual report for the period ending June 30, 1978.** Cromack, D.E. (Massachusetts Univ., Amherst (USA). Energy Alternatives Program). Oct 1979. Contract AC04-76DP03533. 116p. NTIS, PC A06/MF A01.

This report presents the background and progress to date for the Wind Furnace project at the University of Massachusetts. The organization of the report gives a general description of the Wind Furnace installed at Solar Habitat-I with performance and operational data of general inerest. More detail is presented under the summary discussions for each task with referenced technical reports and published papers giving a full description of the specific tasks.

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 28899

28903 (DOE/DP/03533—T1(Vol.1)) **Development of an 8 kW wind turbine generator for residential type applications. Phase I: design and analysis. Volume 1. Executive summary.** Cheney, M.C. (United Technologies Research Center, East Hartford, CT (USA)). 25 Jun 1979. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01.

The Composite Bearingless Wind Turbine was developed at the United Technologies Research Center following many years of bearingless rotor research and development for helicopter applications. The current 8 kW contract was begun in October 1977 with delivery of the prototype scheduled for November 1979. The contract consists of two phases. Phase I encompasses the complete design of the system and supporting analytical and experimental studies. The Phase I final report has been completed, and this executive summary highlights the principal findings described in that report.

28904 (DOE/DP/03533—T1(Vol.2)) **Development of an 8 kW wind turbine generator for residential type applications. Phase I: design and analysis. Volume II. Technical report.** Cheney, M.C. (United Technologies Research Center, East Hartford, CT (USA)). 25 Jun 1979. Contract AC04-76DP03533. 126p. NTIS, PC A07/MF A01.

This Phase I summary report contains a description of the 8 kW wind energy conversion system developed by the United Technologies Research Center (UTRC) for the Department of Energy.

The wind turbine employs the UTRC Bearingless Rotor Concept in conjunction with a passive pendulum control system which controls blade pitch for start-up, efficient power generation, and high-speed survivability. The report contains a summary of the experimental and analytical programs in support of design efforts. These supporting programs include materials tests, a wind tunnel program, and aeroelastic analyses to evaluate system stability. An estimate is also made of the projected manufacturing cost of the system if produced in quantity.

28905 (DOE/NASA/3139—1) **Nonlinear aeroelastic equations of motion of twisted, nonuniform, flexible horizontal-axis wind turbine blades.** Kaza, K.R.V. (Toledo Univ., OH (USA)). Jul 1980. Contract AI01-76ET20320. 72p. NTIS, PC A04/MF A01.

The second-degree nonlinear equations of motion for a flexible, twisted, nonuniform, horizontal-axis wind turbine blade are developed using Hamilton's principle. The derivation of the equations has its basis in the geometric nonlinear theory of elasticity, and the final equations are consistent with the small deformation approximation in which the elongations and shears are negligible compared to unity and the square of the derivative of the extensional deformation of the elastic axis is negligible compared to the squares of the bending slopes. A mathematical ordering scheme which is consistent with the assumption of a slender beam is used to discard some higher-order elastic and inertial terms in the second-degree nonlinear equations. The blade aerodynamic loading which is employed accounts for both wind shear and tower shadow and is obtained from strip theory based on a quasi-steady approximation of two-dimensional, incompressible, unsteady, airfoil theory. The resulting equations have periodic coefficients and are suitable for determining the aeroelastic stability and response of large horizontal-axis wind turbine blades.

28906 **MOD-2 wind turbine.** Lowe, J.E. (Boeing Engineering and Construction Co., Seattle, WA). *Trans. Am. Nucl. Soc.;* **33**: 21-22(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SITE CHARACTERISTICS

28907 (RLO—2439-79/3) **Analytical studies of wind turbine turning characteristics.** Mikhail, A.S.; Justus, C.G. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). Jun 1979. Contract AS06-76ET20355. 26p. NTIS, PC A03/MF A01.

Data from 14 sites were arranged in time-series format for wind speed and direction. The sites were chosen based on the availability of hourly observations and suitability of the sites for wind energy applications (high wind regimes). The hourly turns of the wind were summed vectorially (cyclonic, or counterclockwise, turning defined as positive). Monthly and annual cumulative turns at each site were computed. To simulate the performance of actual wind turbines, threshold wind speed values of 0, 1, 2, 3, 4, 5, and 6 m/s were chosen. A threshold wind speed is defined as wind speed below which the wind turbine is not expected to turn with the wind.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 29195, 29197

POWER PLANTS AND POWER GENERATION

28908 (GFETC/IC—79/1, pp 17-49) **Unique features of the Antelope Valley Station.** Davis, R.A. (Basin Electric Power Cooperative, Bismarck, ND); Battenhouse, R.T. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

Problems encountered in location of a mine-mouth plant, in use of lignite for fuel, in design of boilers, in flue-gas desulfurization, and in supply of water are discussed and solutions indicated. The Antelope Valley Station consists of two 400-MW units. The first of these is to be commercially available in April 1982, and the second, in November 1983. Conservative in design, the furnace is 277 ft in height with a furnace to depth ratio of 1.198. Heat release rate is 77,000 Btu/ft^2-hr. Mine pulverizers are supplied per boiler, each with a capacity of 100,000 lb/hr of lignite having a HGI of 25. The sootblower system includes four types of cleaning devices. A dry SO_2 scrubbing/particulate removal system is to be used. A major problem existed in design and placement of footings in the glacial till of the Beulah Trench. Approximately 106 miles of steel and concrete pilings are installed. The steam generators are designed to provide up to 650,000 lb/hr of process steam to the proposed American Natural Gas Company's gasification plant. The water supply system is designed for joint use.

28909 (GFETC/IC—79/1, pp 50-74) **Brown coal utilization in Australia: the 2000 MW Loy Yang Project.** Higgins, R.S.; Sutherland, K.N. (State Electricity Commission of Victoria, Australia). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The coal resources of the Latrobe Valley and the characteristics of coal mined in the Loy Yang open cut are presented. These soft brown coals on a dry basis have 1 to 5% ash, 45 to 55% volatile matter, and 66 to 69% carbon. Moisture contents are from 50 to 70%. Estimated production is 3 million metric tons per year (mtpy) in 1984, and 30 million mtpy by 1994. Four 500/MW boilers, now under construction, are described and design parameters discussed, including the boiler design fuel, milling and combustion system, convection surfaces, air heater, and on-load cleaning equipment. Special attention is given to particulate collection, NO/sub x/ and SO_4 emissions, and disposal of ash and effluents.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

28910 **Investigations of sparging as a method for promoting cooling pond heat transfer.** Hicks, B.B. (Argonne National Lab., IL). *J. Appl. Meteorol.;* **19**: No. 2, 193-198(Feb 1980).

Destruction of the thin subsurface thermal boundary layer at an air-water interface can be accomplished by relatively low rates of aeration and can result in substantially improved thermal performance when water temperatures are high. The heating and saturating of rising air bubbles can also provide a significant improvement in overall thermal performance when water temperatures and aeration rates are sufficiently great. At 80°C, improvements of $\sim$ 20% appear possible with average aeration rates < 1 mm s^{-1}.

POWER CYCLES

REFER ALSO TO CITATION(S) 28370

28911 (DOE/NASA/2593—17) **Effect on combined cycle efficiency of stack gas temperature constraints to avoid acid corrosion.** Nainiger, J.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1980. Contract AI01-77ET10350. 17p. NTIS, PC A02/MF A01.

The effect on combined cycle performance of raising the stack gas temperatures to levels high enough to avoid corrosion when burning fuels containing sulfur is presented and discussed. The use of fuels containing sulfur requires that the cold-end heat exchanger surface and exhaust stack gas temperatures be kept above the sulfuric acid condensation temperatures. Sulfur in the fuel results in acid formation which then requires a higher stack inlet temperature compared to low-sulfur fuel. Raising the exhaust stack gas temperature, however, results in lower combined cycle efficiency compared to a combined cycle system burning a sulfur-free fuel. Dew points were estimated as a function of fuel sulfur content and gas turbine design parameters. An empirical correlation was used for these dew point calculations. The effect on combined cycle efficiency was determined for air-cooled and water-cooled gas turbine combined cycle systems. Combined cycle performance calculations were made assuming first a sulfur-free fuel and then a fuel with 0.8% sulfur by weight. This is the maximum sulfur content for a liquid fuel that can be used without sulfur dioxide emission control devices and still meet environmental regulations. The maximum difference between the combined cycle performance using sulfur-free fuel and using the 0.8% sulfur fuel was less than one percentage point in efficiency.

28912 (EPRI-AF—1308) **Description of efficient, fuel-flexible, combustion turbine plants for small electric utilities. Summary and final report.** Carlson, P.G.; Duffy, T.E.; Roberts, P.B. (Solar Turbines International, San Diego, CA (USA)). Dec 1979. 101p. NTIS, PC A06/MF A01.

Results are presented of a study which describes the design concept for two small combustion turbine combined cycle power plants, and projects anticipated performance and operating economics. Both plants are in the size range suitable for small utility service and use less than 100 million Btu/hr. One plant is a direct, No. 2 diesel fuel fired, open cycle gas turbine with a heat recovery boiler and steam bottoming cycle. A net plant efficiency of 39.7% (HHV) is predicted at 11.56 MW(e) output with a turbine rotor inlet temperature of 1935°F. Capital cost for this system (1979 dollars) is estimated to fall into a band of $545/kW to $660/kW. This system is projected as being capable of commercial development by 1985 with normal technical development progress. The other power plant is based on an indirect fired open cycle gas turbine with a steam bottoming cycle. It is rated at 3.78 MW(e) with a net plant (combined cycle) efficiency of 25.0% (not including stack gas cleanup parasitic power losses) when burning Illinois No. 6 coal. Turbine rotor inlet temperature is 1550°F. The projected capital cost (1979 dollars) is in the band of $1385/kW to $1675/kW. Additional development is required to bring this system to commercialization. As-

suming adequate development effort, the system described could be available by !985. Both of the above described systems have cogenerated potential and are based on existing turbomachinery. However, the 11.56 MW(e) cycle is based on a growth rating (1935°F TRIT) of an engine currently rated at 1800°F TRIT.

28913 (EPRI-AP—1390) **Coal gasification combined-cycle system analysis. Final report.** Hamilton, S.; Garow, J.; Lehman, S.J. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Apr 1980. 178p. NTIS, PC A09/MF A01.

This report summarizes the results of the second phase of a study involving combustion turbine power plants using coal gasification. The study concentrated on systems integration and the optimization of power plant conceptual designs. In order of importance, the objectives of the study were to: (1) determine potential levels of thermal efficiency for well integrated gasified coal combined cycle (GCC) systems employing current technology combustion turbines and near-commercial, oxygen-blown Texaco gasifiers. (2) Quantify the effects of varying key design parameters of various components on overall plant performance. (3) Project potential levels of performance made possible by using advanced, combustion turbines and advanced gasifiers in well-integrated gasification power plants. To meet these objectives emphasis was placed on effective waste heat management and practicality in synthesizing overall power plant arrangements. Evaluations were confined to thermodynamic analysis and did not include equipment cost estimation. Current technology systems were defined which yielded thermal efficiencies in the range of 35 to 37%. It was found that approximately one percentage point in thermal efficiency could be realized by using either the British Gas Corporation (BGC) slagging, fixed-bed gasifier or the air-blown Texaco gasifier in place of the oxygen-blown Texaco gasifier. Two percentage points were gained by increasing the gas turbine combustor exit temperature about 300°F. These results suggest the possibility of approaching 40% in practical future power plants. Cost-effective configurations with such performance levels are expected to offer a more than competitive alternative to conventional coal-fired steam power plants equipped to meet emission standards.

28914 (FE—1806-83) **High-Temperture Turbine Technology Program. Overall plant design description (OPDD) low-Btu coal gas electric power plant.** Horner, M.W. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Mar 1980. Contract EX-76-C-01-1806. 241p. NTIS, PC A11/MF A01.

This report describes the Low-Btu Coal Gas Combined Cycle Electric Power Plant concept developed during Phase II of the US Department of Energy High Temperature Turbine Technology (DOE-HTTT) Program. The report defines a highly reliable, commercially viable system based on coal-derived fuel. This definition builds on and updates the Phase I study of the Low-Btu Coal Gasification Combined Cycle System. The system consists mainly of high-temperature, water-cooled gas turbines that burn coal-derived gas fuel, and a steam bottoming cycle with one reheat steam turbine. The coal gasifiers, low-Btu gas cleanup, and plant support equipment definitions are also based on approaches initially described in DOE-HTTT report FE-1806-23, High-Temperature Turbine Technology Program, Overall Plant Design Description, Low-Btu Coal Gas Electric Power Plant. Significant changes (from Phase I) in the hardware and its functional sequencing are included and a more detailed description of the organization, operation, and control of the integrated system is presented. The main changes are the addition of a Raw Gas Steam Generator (RGSG) at the gasifier exit and the use of the smaller PRD-6 gas turbines in lieu of the PRD-7 gas turbines. The combined-cycle system specified in this report provides improved flexibility of operation as well as reliability and efficiency.

28915 (FE—1806-84) **High-temperature turbine Technology Program. Overall plant design description (OPDD) coal-derived liquid electric power plant.** Horner, M.W. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Mar 1980. Contract EX-76-C-01-1806. 192p. NTIS, PC A09/MF A01.

This report describes the Coal-Derived Liquid Combined Cycle Power System concept developed during Phase II of the US Department of Energy High Temperature Turbine Technology (DOE-HTTT) Program. The report defines a highly reliable, commercially viable system based on coal-derived liquid (CDL) fuel. This definition builds on the Phase I study through its focus on a coal-derived liquid fueled, high firing temperature, water-cooled gas turbine system with a steam bottoming plant that has one reheat steam turbine. The CDL fuel handling lant and support system concepts are also based on approaches initially described in DOE-HTTT Report FE-1806-24, High-Temperature Turbine Technology Program, Overall Plant Design Description, Coal-Derived Liquid Electric Power Plant. Significant changes in the hardware and its functional sequencing are included and a more detailed exposition of the organization, operation, and control of the integrated system is presented. The combined-cycle system specified in this report provides improved flexibility of operation as well as reliability and efficiency. The PRD-6 gas turbine utilized in the system design has a 12:1 pressure ratio, compressor inlet air flow of 300 lb/second, and a 2600°F firing temperature. The performance characteristics of the overall plant are given.

28916 (FE—2357-50) **PFB coal fired combined cycle development program. Quarterly report, October-December 1978.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1978. Contract EX-76-C-01-2357. 29p. NTIS, PC A03/MF A01.

The CURL 10 x 100 Hour Test Plan is in the process of being revised to incorporate the comments received at the review meeting held on October 22, 1978. It is planned to submit a preliminary draft of the test plan in early February. Upon receipt of comments from all test participants a final version of the Test Plan will be issued. Evaluation of the initially proposed 10 x 100 Hour Test cyclone configuration indicated that adequate erosion protection to the turbine cascade would not be provided. Hence, a number of alternate cyclone configurations were considered. The decision was made to install two 10 inch cyclones, modified to simulate Exxon inlet conditions in separate vessels. The design of the G.E. materials test section featuring cooled and uncooled specimens with erosion targets has been completed. Also, the adequacy of the blade cooling design has been confirmed through the implementation of a three dimensional heat transfer analysis of the airfoil and erosion bar.

28917 (TE—4231-117-78(Vol.1)) **Venture analysis case study. Steam Rankine recovery cycle producing electric power from waste heat. .** (Thermo Electron Corp., Waltham, MA (USA)). Dec 1978. Contract EX-77-C-01-2685. 298p. NTIS, PC A13/MF A01.

A case-specific private and public sector methodology is presented for the Steam Rankine Heat Recovery System. The objectives of the case study were: (1) to determine if the Steam Rankine Heat Recovery System would be a successful venture for producers, (2) to determine if introduction of this technology is for the public good, (3) to determine whether the government should provide incentives to further encourage its commercialization. It is concluded that government incentives, particularly instant tax credits and accelerated depreciation schedules, can significantly increase the rate of market penetration, and that government stimulation would be economically beneficial to the public sector. DOE will utilize this and other case studies in synthesizing a private and public sector venture analysis program to aid their program planning efforts.

28918 (TE—4231-117-78(Vol.2)) **Venture analysis case study. Steam Rankine recovery cycle producing electric power from waste heat. Volume 2. Appendices.** (Thermo Electron Corp., Waltham, MA (USA)). Dec 1978. Contract EX-77-C-01-2685. 164p. NTIS, PC A08/MF A01.

The appendixes to the study to assess the steam Rankine recovery cycle to produce electric power from waste heat are presented. Information is presented on the following: mathematical formulations for venture analysis; distribution functions of key variables for use in Monte Carlo analysis; user capital availability; market potential by industry; and typical SRRC user/producer Pro-Forma statements.

28919 (TE—4231-117-78(Exec.Summ.)) **Venture analysis case study. Steam Rankine recovery cycle producing electric power from waste heat. Executive summary.** (Thermo Electron Corp., Waltham, MA (USA)). Dec 1978. Contract EX-77-C-01-2685. 37p. NTIS, PC A03/MF A01.

In 1980 the private sector economic potential market for Steam Turbine Rankine Recovery Systems is expected to be about 600 MW and the cumulative sales 30 MW, based upon the most likely set of data inputs, compared to a societally beneficial efficient public sector market of 1050 MW. In 1990, the private sector potential market for Steam Turbine Rankine Recovery Systems is expected to increase to about 1000 MW and the cumulative sales to 430 MW, based upon the most likely set of data inputs, compared to a societally beneficial efficient public sector market of 1840 MW.

COMPONENTS

REFER ALSO TO CITATION(S) 28912

28920 (EPRI-AP—1369) **Parameter monitoring for corrosion control of utility gas turbines. Annual report, March 1980.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1980. 104p. NTIS, PC A06/MF A01.

Hot corrosion of turbine airfoil materials is the durability limiting factor in industrial gas turbine engines. It is caused primarily by alkali sulfates depositing on the turbine airfoils. The primary objectives of this phase of the program were to determine from field and laboratory test data the conditions that cause deposition of these corrodents and to define an engine control system that will minimize their effect. Field data on 600 engines were statistically analyzed to determine the influence on hot corrosion of: fuel type; engine washing; air filtration; and proximity of the engine sites to oceans. Laboratory tests were conducted to determine the effect of: sodium

sulfate with and without impurities; temperature cycling; and sodium in the fuel. The primary source of sodium is airborne sea salt and contaminated fuel. Atmospheric and fuel-salt concentrations have been measured at a variety of US sites. Sodium ion concentrations in the air stream inside engines were monitored for evidence of impulsive shedding of accumulated salt. Results show that intermittent water washing reduces the incidence of corrosion since turbine materials can tolerate alkali sulfates for a limited period before hot corrosion commences. An engine control system which monitors the atmospheric and fuel-borne salt concentrations and signals the need for an engine water wash cycle to remove accumulated salt before corrosion commences has been designed, built, installed and checked out. This unit can also reduce power, therefore temperature, to slow the corrosion rate if the wash is not performed. The next phase of this program will be to operate two engines with and without the control at the Long Island Lighting Company (LILCO) Holbrook site to verify the value and durability of the system.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 28627, 28917, 28918, 28919, 29258

ECONOMICS

REFER ALSO TO CITATION(S) 29196, 29268

28921 **Conventional and advanced coal-fired power stations.** Pohl, J.H. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* 33: 12-14(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 29157

FUELS

28922 (EPRI-CS—1318) **Electric utility use of fireside additives. Final report.** Locklin, D.W.; Krause, H.H.; Anson, D.; Reid, W. (Battelle Columbus Labs., OH (USA)). Jan 1980. 304p. NTIS, PC A14/MF A01.

Fireside additives have been used or proposed for use in fossil-fired utility boilers to combat a number of problems related to boiler performance and reliability. These problems include corrosion, fouling, superheat control, and acidic emissions. Fuel additives and other fireside additives have been used mainly with oil firing; however, there is growing experience with additives in coal-firing, especially for flyash conditioning to improve the performance of electrostatic precipitators. In decisions regarding the selection and use of additives, utilities have had to rely extensively on empiricism, due partly to an incomplete understanding of processes involved and partly to the limited amount of quantitative data. The study reported here was sponsored by the Electric Power Research Institute to assemble and analyze pertinent operating experience and to recommend guidelines for utility decisions on the use of additives. The combined results of the state-of-the-art review of technical literature and a special survey of utility experience are reported. A total of 38 utilities participated in the survey, providing information on trials conducted on 104 units in 93 different plants. Altogether, 445 separate trials were reported, each representing a unit/additive/fuel combination. Additives used in these trials included 90 different additive formulations, both pure compounds and proprietary products. These formulations were categorized into 37 generic classes according to their chemical constituents, and the results of the survey are presented by these generic classes. The findings are organized according to the operating problems for which fireside additives are used. Guidelines are presented for utility use in additive selection and in planning additive trials.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 28332, 29625, 29741

28923 **Chalk Point cooling tower program: an overview.** Moon, M.L. (Johns Hopkins Univ., Laurel, MD). *Trans. Am. Nucl. Soc.;* 33: 176-178(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28924 **Downwind sulfur dioxide concentration calculations for four corners generating station.** Lee, W.H. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 197-198(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

THERMAL EFFLUENTS

28925 (RAND/N—1479-DOE) **Anomalous snowfall caused by natural-draft cooling towers.** Koenig, L.R. (RAND Corp., Santa Monica, CA (USA)). May 1980. Contract AC03-76EV01191. 49p. NTIS, PC A03/MF A01.

Scattered reports of significant amounts of snow anomalously produced by cooling-tower plumes suggest that this process may be of importance. This conclusion is supported by study of high-resolution satellite images. Tabulation of a number of aerial observations of plumes at subfreezing temperatures indicates that a plume is likely to produce measurable snow if its temperature is colder than -13°C and the saturation deficit of the ambient air is less than 0.5 g m^{-3}. These factors are important because they affect the rates of nucleation and growth of ice particles. The rate of mixing between plume and ambient air is also important because it affects the rate of evaporation within the plume, which in turn determines the length of time available for snow particles to grow large enough to fall out. These empirically derived criteria were tested using a numerical model of cloud microphysics that simulates the most important processes of transfer of water substance between vapor, liquid, and ice, including nucleation and development of particle-size spectra. Dynamic processes were specified, not modeled. Among the many quantities computed is the flux density of snow at the base of the plume. From this, together with average fallspeed and horizontal wind speed, one can compute the amount and pattern of snowfall at the ground.

28926 **Effects of atmospheric heat releases from electric power generating sites.** Koenig, L.R.; Murray, F.W. (Rand Corp., Santa Monica, CA). *Trans. Am. Nucl. Soc.;* 33: 178(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 28331, 28334, 28335, 28362, 28908

28927 **Terpolymerization of ethylene, sulfur dioxide and carbon monoxide.** Johnson, R.; Steinberg, M. US Patent Application 026,508. [nd]. 24p.

This invention relates to high molecular weight terpolymer of ethylene, sulfur dioxide and carbon monoxide stable to 280°C and containing as little as 36 mol% ethylene and about 41 to 51 mol% sulfur dioxide, and to the method of producing said terpolymer by irradiation of a liquid and gaseous mixture of ethylene, sulfur dioxide and carbon monoxide by means of Co-60 gamma rays or an electron beam, at a temperature of about 10 to 50°C, and at a pressure of about 140 to 680 atmospheres, to initiate polymerization.

28928 (FE—2018-15) **Fundamentals of nitric oxide formation in fossil fuel combustion. Progress report, 29 September-28 December 1979.** Houser, T. (Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry). Jun 1980. Contract AC01-76ET10593. 12p. NTIS, PC A02/MF A01.

A rate equation for the oxidation of pyridine in the temperature range of 948 to 1048°K and for both fuel lean and rich mixtures has been developed to describe the data previously reported. The rate appears to be first-order in oxygen and half-order each in pyridine and oxygen consumed, indicating catalysis by product(s). The Arrhenius parameters are 46,800 kcal/mole and 13.4 for E/sub a/ and log A (in 1/mole . sec) respectively. Measurements of the products indicated, at all temperatures from 948 to 1273°K, that HCN was the major (and only significant) volatile product containing nitrogen for fuel rich mixtures. However, only at 1273°K were there large amounts of NO produced from fuel lean mixtures; at 1173°K and below only very small yields of NO, about 1% or less, were found. The papers on pyridine pyrolysis kinetics were revised and resubmitted.

28929 (FE—2018-16) **Fundamentals of nitric oxide formation in fossil fuel combustion. Progress report, 29 December 1979-28 March 1980.** Houser, T.; McCarville, M.E. (Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry). Jun 1980. Contract AC01-76ET10593. 10p. NTIS, PC A02/MF A01.

It was necessary to again revise the papers on the kinetics of pyridine pyrolysis after which they were accepted by the International Journal of Chemical Kinetics. The revised consideration of the rate of formation of HCN required an algebraic derivation to produce a new rate equation. If it is assumed that a fraction (α) of the decomposed pyridine forms an intermediate, a fraction of which (β) is capable of reacting further to form HCN, and that that formation is first-order in intermediate, the following rate equation describes the data: rho/t = k/sub b/$\alpha\beta$-k/sub b/rho. Where rho is moles HCN formed/mole pyridine decomposed, t is contact time and k/sub b/ is the first-order rate constant for the formation step. In

addition. it was shown that since rho was independent of initial pyridine concentration, the formation step was necessarily first-order. The Arrhenius parameters for k/sub b/ were 39.5 kcal/mole and 6.8 for E/sub a/ and log A (sec^{-1}) respectively. At 950 and 1000°C it was found that $\alpha\beta$ product was one, indicating all the pyridine could form HCN given enough time to react, whereas at 900°C the maximum HCN formed would be only about 60% of the pyridine decomposed. Finally, it was determined that the fraction of decomposed pyridine which can form HCN at a given time ranged from 0.16 to 0.77, indicating a significant concentration of intermediate builds up at all conditions. No volatile product found in the pyrolysis is close to that range of yields, thus the precursor to the HCN must react further on leaving the reactor.

28930 Investigation of mathematical models for cooling tower plumes and drift. Policastro, A.J. (Argonne National Lab., IL); Dunn, W.E.; Carhart, R.A. *Trans. Am. Nucl. Soc.;* **33**: 178-179(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28931 Airborne plume dispersion from two-dimensional computational hydrodynamic simulations. Bennett, R.G.; Golay, M.W. (Massachusetts Inst. of Tech., Cambridge). *Trans. Am. Nucl. Soc.;* **33**: 179-180(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 29203

POWER TRANSMISSION AND DISTRIBUTION

28932 (EPRI-EL—809-SY) **Evaluation of alternative insulating oils for use in transformers and other electrical apparatus: characteristics of insulating oils for electrical application.** Rouse, T.O. (General Electric Co., Pittsfield, MA (USA)). Feb 1980. 100p. NTIS, PC A05/MF A01.

There is a realistic possibility that demand for traditional naphthenic transformer oils will exceed the available supply in the mid 1980's. The results of a program directed toward evaluating alternate fluids are summarized. Oils derived from paraffinic crude sources are predicted to be more plentiful. The results of studies suggest that these paraffinic oils will be a satisfactory supplement or replacement fluids. Because of the differences in low temperature behavior of the two types of oils, careful consideration will have to be given to matching a given oil to a given application.

28933 (EPRI-EL—1300) **Characteristics of insulating oil for electrical application. Final report.** Sloat, T.K. (Westinghouse Electric Corp., Sharon, PA (USA)). Dec 1979. 303p. NTIS, PC A14/MF A01.

It has been established that the supply of naphthenic type of petroleum crudes historically used for the manufacture of electrical insulating oils is diminishing, and the oil companies have recommended that the more readily available paraffinic types of crudes should be substituted to produce the insulating oil required by the electrical industry. The purpose of this project was to determine if an insulating oil manufactured from paraffinic-type crudes was interchangeable with the presently accepted insulating oil and would perform the same function without major changes in designs or limit operating conditons. Paraffinic crude oils are known to contain significant amounts of wax that, if not removed, could provide an insulating oil having a high pour point which could interfere with the low-temperature functioning of most electrical equipment. Because of the wax problem, it was necessary to study the behavior of the paraffinic-base insulating oil in representative production-size equipment, such as tap changers and power circuit breakers, to be sure that the equipment would operate if exposed to temperatures as low as 40°C. Other studies, such as material compatibility, lubricity of the new oil, arc-formed gas, response to dielectric breakdown levels represented in large power transformers, and accelerated aging in distribution transformers, were important to ensure full acceptance of a replacement oil. The work in this project was separated into different phases in order to provide a broad study of the new type of insulating oil. This evaluation of experimental oils indicated that paraffinic transformer oils as a class can provide useful supplements or replacements for naphthenic oils.

28934 (EPRI-EL—1302) **Oil tests in tap changers.** Barich, S.; Brysh, B.L.; Sloat, T.K. (Westinghouse Electric Corp., Sharon, PA (USA)). Dec 1979. 115p. NTIS, PC A06/MF A01.

Evaluation of the operation of two Westinghouse load tap changers (LTCs) was made to determine their performance in one naphthenic-type EPRI oil, NH, and in one paraffinic-type EPRI experimental oil, PB. The evaluation was based on the following: both LTCs were operated mechanically to temperatures to -40°C in both oils with various motor supply voltages and through different tap position changes; load interruption capability of a LTC that interrupts the arc in the oil was determined by interrupting a 1000-amp load approximately 150,000 times in both oils; and a mechanical life test of one-million operations was conducted. No appreciable difference was noted in the operation of the LTCs in the two oils.

28935 Dielectric gas mixtures containing sulfur hexafluoride. Cooke, C.M. (to Dept. of Energy). US Patent 4,162,227. 24 Jul 1979. Filed date 24 Feb 1976. 6p.

PAT-APPL-660,887.

Electrically insulating gaseous media of unexpectedly high dielectric strength comprised of mixtures of two or more dielectric gases are disclosed wherein the dielectric strength of at least one gas in each mixture increases at less than a linear rate with increasing pressure and the mixture gases are present in such proportions that the sum of their electrical discharge voltages at their respective partial pressures exceeds the electrical discharge voltage of each individual gas at the same temperature and pressure as that of the mixture. 1 claim.

AC SYSTEMS, EHV AND UHV

28936 (DOE/RA/2133—01) **Electrical and mechanical design criteria for EHV and UHV: overhead transmission lines.** (Main (Charles T.), Inc., Boston, MA (USA)). Jun 1980. Contract AC01-77ET29236. 102p. NTIS, PC A06/MF A01.

The results are presented of a program devoted to the selection of electrical and mechanical design criteria and parameters for overhead power transmission lines for ac systems rated at from 345 to 1100 kV and for dc systems rated at from 600 to 1200 kV. Information is included on the environmental effects, i.e., audible noise and electric fields, of the lines, mechanical and economic requirements, safety, failures, grounding, and lightning protection. (LCL)

28937 (INT/DES—80-37) **Proposed Four Corners-Ambrosia-Pajarito 500 kV transmission project. Draft environmental statement.** (Bureau of Indian Affairs, Window Rock, AZ (USA). Navajo Area Office). 1980. 212p. Department of the Interior, Bureau of Indian Affairs, Navajo Area Office, Window Rock, AZ.

The Public Service Company of New Mexico proposes to construct and operate a 500 kV alternating current (ac) transmission line in the northwestern portion of New Mexico. The proposed line will extend from the Four Corners Power Plant to Ambrosia Station to a proposed Pajarito Station west of Albuquerque, NM. The proposed line will be approximately 173 miles in length. Construction of the 500 kV transmission line will adversely impact soils, vegetation, visual resources, and possibly in an indirect manner, the cultural resources in the area. These adverse impacts may be made minimal by the practice of erosion protection measures, revegetation, and a sound cultural resource management plan. There will be no appreciable impacts, adverse or otherwise in regard to surface or subsurface water by the construction or operation of the proposed transmission line. No adverse effects may be anticipated in regard to communities or social services. Economic impacts in the area will be short-term and should prove beneficial for the duration of the project. Construction and operation of this line will be beneficial in providing needed additional bulk transmission capacity between the Four Corners Plant and Albuquerque and bulk transmission support to the local western New Mexico area.

DC SYSTEMS

REFER ALSO TO CITATION(S) 28936

28938 (DOE/ET/29355—T6) **Performance of a technical and economical feasibility study of an hvdc compressed gas insulated transmission line. Technical status report No. 6 for the period of May 1980.** (Aluminum Co. of America, Alcoa Center, PA. Alcoa Technical Center). 12 Jun 1980. Contract AC01-79ET29355. 35p. NTIS, PC A03/MF A01.

The feasibility of a 1300 kV basic insulation level (BIL) with respect to lightning surges was assessed for an hvdc compressed gas insulated transmission line. The mechanism by which overvoltages within the cable ca: exceed the protective level of the arresters at the cable terminals is outlined. The parameters of lightning currents are discussed. These parameters and the design of the overhead line are the controlling factors on the shape and the magnitude of lightning surges. The results of computed overvoltages within the cable are presented. The results illustrate the benefits of two protective schemes. One scheme is used to lengthen the front and to slow down the rate of rise of the surge into the cable. The other scheme is used to do likewise to the reflected surge at the station-end of the cable. These preliminary results indicate that a 1300 kV BIL is feasible with additional arresters on the overhead line or with additional capacitors at the station.

NUCLEAR POWER PLANTS

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 28980, 29006, 29007, 29011, 29012, 29013, 29015, 29016, 29022, 29056, 29058, 29082, 29084, 29092, 29093, 29094, 29098, 29099, 29100, 29101, 29110, 29112, 29113, 29114, 29115, 29116, 29124, 29128, 29147, 29148, 29152, 29302

28939 (ALO—73) **Investigation of valve failure problems in LWR power plants.** (Burns and Roe, Inc., Oradell, NJ (USA)). Apr 1980. Contract AC04-76DP00789. 351p. NTIS, PC A16/MF A01.

An analysis of component failures from information in the computerized Nuclear Safety Information Center (NSIC) data bank shows that for both PWR and BWR plants the component category most responsible for approximately 19.3% of light water reactor (LWR) power plant shutdowns. This investigation by Burns and Roe, Inc. shows that the greatest cause of shutdowns in LWRs due to valve failures is leakage from valve stem packing. Both BWR plants and PWR plants have stem leakage problems (BWRs, 21% and PWRs, 34%).

28940 (SAND—80-0684) **Technical program to study the benefits of nonlinear analysis methods in LWR component designs. Technical report TR-3723-1.** Raju, P.P. (Teledyne Engineering Services, Waltham, MA (USA)). May 1980. Contract AC04-76DP00789. 91p. (ALO—82). NTIS, PC A05/MF A01.

This report summarizes the results of the study program to assess the benefits of nonlinear analysis methods in Light Water Reactor (LWR) component designs. The current study reveals that despite its increased cost and other complexities, nonlinear analysis is a practical and valuable tool for the design of LWR components, especially under ASME Level D service conditions (faulted conditions) and it will greatly assist in the evaluation of ductile fracture potential of pressure boundary components. Since the nonlinear behavior is generally a local phenomenon, the design of complex components can be accomplished through substructuring isolated localized regions and evaluating them in detail using nonlinear analysis methods.

28941 **Mechanistic prediction of transient fission-gas release from LWR fuel.** Rest, J.; Gehl, S.M. (Argonne National Lab., IL (USA). Materials Science Div.). *Nucl. Eng. Des.;* **56**: No. 1, 233-256(Feb 1980).

From IAEA specialists' meeting on fuel element performance computer modelling; Blackpool, UK (13 - 17 Mar 1978).

The steady-state and transient gas release and swelling subroutine (GRASS-SST) is a mechanistic computer code for the prediction of fission-gas behavior in UO_2-base fuels. GRASS-SST treats fission-gas release and fuel swelling on an equal basis and simultaneously treats all major mechanisms that influence fission-gas behavior. The GRASS-SST transient analysis has evolved through comparisons of code predictions with the fission-gas release and physical phenomena that occur during reactor operation and transient direct-electrical heating (DEH) testing of irradiated light-water reactor fuel. The GRASS-SST steady-state analysis has undergone verification for end-of-life fission-gas release and intragranular bubble-size distributions. The results of GRASS-SST predictions for transient fission-gas release during DEH tests are in good agreement with experimental data. Comparisons of GRASS-SST predictions of gas release and bubble-size distributions with the results of DEH transient tests indicate that (1) coalescing bubbles do not have sufficient time to grow to equilibrium size during most transient conditions, (2) mobilities of fission-gas bubbles in UO_2 are enhanced nonequilibrium conditions if the excess pressure in the bubble is sufficient to generate an equivalent stress greater or equal to the yield stress of the surrounding matrix, and (3) channel formation on grain surfaces and coalescence of the channels with each other and with the tunnels of gas along the grain edges can contribute to grain-boundary separation and/or the rapid, long-range interconnection of porosity. The phenomena of grain-boundary separation and/or long-range interconnection of porosity provides an important release mechanism for fission gas that has moved out of the grains of irradiated fuel.

28942 **Nondestructive evaluation of multizoned gadolinia-bearing UO_2 rods.** Schoenig, F.C. Jr. (General Electric Co., Wilmington, NC); Landry, J.D.; Goldman, M.I.; Bernatowicz, H.; Arya, S.P.; Grossman, L.N. *Trans. Am. Nucl. Soc.;* **33**: 448-449(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28943 **Implementation of ENDF/B-IV and -V data in LWR design codes: EPRI-CELL and EPRI-CPM.** Ozer, O. (Electric Power Research Inst., Palo Alto, CA); MacFarlane, R.E.; Williams, M.L. *Trans. Am. Nucl. Soc.;* **33**: 820-821(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28944 **Modeling the local component of in-core neutron detector noise in a BWR.** Sweeney, F.J. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 854-855(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28945 **Characterization of operator errors from actual plant operation experience.** Sabri, Z.A. (Iowa Sate Univ., Ames). *Trans. Am. Nucl. Soc.;* **33**: 562-564(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28946 **Stress degradation of operator performance.** Fullwood, R.R. (Science Applications, Inc., Palo Alto, CA); Husseiny, A.A. *Trans. Am. Nucl. Soc.;* **33**: 564-566(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28947 **Comparative performance of FCI-remedy fuel designs.** Wagoner, S.R.; Barner, J.O.; Guenther, R.J. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 271-272(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28948 **Burnup-dependent fission gas release.** Bradley, E.R.; Cunningham, M.E.; Hann, C.R.; Lanning, D.D.; Williford, R.E. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 272-273(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28949 **Thermodynamics of the system uranium dioxide-fission products-zircaloy.** Kohli, R. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). *Trans. Am. Nucl. Soc.;* **33**: 281-282(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28950 **High reactor building airborne activity study.** Jacob, N.P. (Babcock and Wilcox Co., Lynchburg, VA); Bishop, W.N.; Coad, R.B.; Nitti, D.A.; Blue, L.A. *Trans. Am. Nucl. Soc.;* **33**: 689-690(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28951 **Monitoring BWR stability using time series analysis of neutron noise.** Upadhyaya, B.R.; Kitamura, M. (Univ. of Tennessee, Knoxville). *Trans. Am. Nucl. Soc.;* **33**: 342-343(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28952 **Method to calculate optimum power profiles in LWRs.** Winkler, E.N.; Forkner, S.L. (Tennessee Valley Authority, Chattanooga). *Trans. Am. Nucl. Soc.;* **33**: 347-348(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28953 **Investigation of first-order perturbation methods in sensitivity analysis for light-water reactors.** Amorim, E.S.; Ryskamp, J.M.; Malaviya, B.K. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **33**: 348-349(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 28521, 28939, 28940, 28941, 28943, 28945, 28946, 28948, 28949, 28950, 28952, 28953, 28980, 29004, 29005, 29006, 29007, 29008, 29009, 29010, 29012, 29013, 29014, 29015, 29016, 29022, 29057, 29058, 29078, 29082, 29083, 29084, 29085, 29087, 29091, 29092, 29093, 29094, 29097, 29101, 29102, 29103, 29104, 29105, 29106, 29107, 29108, 29109, 29110, 29111, 29112, 29113, 29114, 29115, 29116, 29124, 29128, 29147, 29148, 29152, 29302, 29332

28954 (EML—376) **Spectrometric measurements within the containments of 8 PWRs: a data compilation.** Sanna, R.S.; Hajnal, F.; McLaughlin, J.E.; Ryan, R.M. (Department of Energy, New York

(USA). Environmental Measurements Lab.; Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1980. 121p. NTIS, PC A06/MF A01.

Measurements were made with the multisphere spectrometer to characterize the neutron environment inside the containment of pressureized water power reactors. Differential energy spectra and integral quantities of interest such as the neutron fluence rate and dose equivalent rate were determined. Available energy response data of several neutron monitors were applied to the spectra to predict the performance of these monitors in a PWR environment. Detailed data for each measurement are presented. Summaries of the results along with a discussion of the measurement and analytical techniques used are presented separately.

28955 Power spectral density measurements with ^{252}Cf for a light-water-moderated research reactor. King, W.T. (Univ. of Tennessee, Knoxville); Milhalczo, J.T. *Trans. Am. Nucl. Soc.;* **33**: 796-798(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28956 Simulation of a typical three-loop PWR through application of the ARMP system. Herczeg, J.W.; Todosow, M.; Lai, J.; Diamond, D.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 816-818(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28957 Comparative reliability analysis for PWR, HWR, and LMFBR shutdown heat removal systems. Sun, Y.H.; Bari, R.A. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 568-569(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28958 Assessment of auxiliary feedwater systems. Taylor, M.A. (U.S. Nuclear Regulatory Commission, Washington, DC); Cunningham, M.A.; Asselin, S.V.; Carlson, D.D.; Hickman, J.W.; Kolb, G.J. *Trans. Am. Nucl. Soc.;* **33**: 569-570(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28959 Natural-circulation steam generator model for optimal steam generator water level control. Feeley, J.J. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 607-609(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28960 Millstone Unit No. 2 reactor cavity neutron shield. Weyland, S.J. (Northeast Utilities Service Co., Hartford, CT); Racich, R.M.; Whittlesey, M.W. *Trans. Am. Nucl. Soc.;* **33**: 688(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28961 Comparison of the CASK and EPR multigroup libraries in PWR damage calculations. Carew, J.F.; Lai, J.C.; Aronson, A.L.; Diamond, D.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 703-704(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 29017, 29059, 29088, 29154

28962 (ORNL—5584) **Irradiation performance of HTGR fuel rods in HFIR experiments HRB-11 and -12.** Homan, F.J.; Tiegs, T.N.; Kania, M.J.; Long, E.L. Jr.; Thoms, K.R.; Robbins, J.M.; Wagner, P. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 210p. NTIS, PC A10/MF A01.

Capsules HRB-11 and -12 were irradiated in support of development of weak-acid-resin-derived recycle fuel for the high-enriched uranium (HEU) fuel cycle for the HTGR. Fissil fuel particles with initial oxygen-to-metal ratios between 1.0 and 1.7 performed acceptably to full burnup for HEU fuel. Particles with ratios below 1.0 showed excessive chemical interaction between rare earth fission products and the SiC layer.

28963 (ORNL—5643) **Gas-cooled reactor programs: High-Temperature Gas-Cooled Reactor Base-Technology Program. Annual progress report for period ending December 31, 1979.** (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 290p. NTIS, PC A13/MF A01.

Progress in HTGR studies is reported in the following areas: HTGR chemistry; fueled graphite development; prestressed concrete pressure vessel development; structural materials; HTGR graphite studies; and evaluation of the pebble-bed HTR.

28964 (ORNL/TM—7336) **HTCAP-1: a program for calcuating operating temperatures in HFIR target irradiation experiments.** Kania, M.J.; Howard A.M. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 87p. NTIS, PC A05/MF A01.

The thermal modeling code, HTCAP-1, calculates in-reactor operating temperatures of fueled specimens contained in the High Flux Isotope Reactor (HFIR) target irradiation experiments (HT-series). Temperature calculations are made for loose particle and bonded fuel rod specimens. Maximum particle surface temperatures are calculated for the loose particles and centerline and surface temperatures for the fuel rods. Three computational models are employed to determine fission heat generation rates, capsule heat transfer analysis, and specimen temperatures. This report is also intended to be a users' manual, and the application of HTCAP-1 to the HT-34 irradiation capsule is presented.

28965 Tensile properties of GCFR ribbed cladding. Purohit, A. (Argonne National Lab., IL); Garde, A.M.; Liu, Y.Y.; Acharya, R.T. *Trans. Am. Nucl. Soc.;* **33**: 270-271(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28966 Iodine adsorption on steel in helium. Osborne, M.F.; Briggs, R.B. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 294-296(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28967 Carburization and dimensional stability of Hastelloy X and Alloy 800H in HTGR helium. Inouye, H. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 297-298(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28968 Model calculations of temperature-change effects on graphite properties during irradiation. Cords, H. (Oak Ridge National Lab., TN); Zimmermann, R. *Trans. Am. Nucl. Soc.;* **33**: 300-301(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28969 Examination of the carbothermic conversion process for UO_2-UC_2-C fuel microspheres. Tiegs, S.M.; Stinton, D.P. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 303-304(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28970 Analysis of ThO_2 particle irradiation behavior by gamma spectrometry. Tiegs, T.N. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 306(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28971 Design and qualification of a proliferation-resistant fuel for the HTGR. Homan, F.J. (Oak Ridge National Lab., TN); Stansfield, O.M. *Trans. Am. Nucl. Soc.;* **33**: 308-309(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28972 Comparison of observed and predicted HTGR fuel performance for hypothetical core heatup conditions. Smith, C.L.; Foster, R.E. (Genenal Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 311-312(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28973 Study of the behavior of tritium in the Peach Bottom HTGR. Dyer, F.F.; Wichner, R.P. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 312-314(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28974 Fort St. Vrain HTGR refueling equipment dose rate calculations vs measurements. Engholm, B.A. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 690-692(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 28957, 29022, 29303, 29306

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 28957, 29054, 29055, 29080, 29081, 29086, 29089, 29090, 29095, 29096, 29117, 29119, 29122, 29123, 29126, 29127, 29129, 29130, 29131, 29132, 29133, 29134, 29135, 29136, 29137, 29138, 29139, 29140, 29141, 29142, 29143, 29144, 29145, 29146, 29151, 29153, 29325, 29340, 29359

28975 (DOE-tr—114) **Design, irradiation, and post-irradiation examination of the (U,Pu)C fuel pins of the test groups 6a and 6c.** Steiner, H.; Weimar, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- and Festkoerperforschung). [nd]. Translation of KFK—2577, March 1978. 212p. NTIS (US Sales Only), PC A10/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

In the frame of the DeBeNe carbide program for the development of a carbide bundle 13 encapsulated gas-bonded fuel pins of the experimental group 6a and 6c were irradiated in the thermal flux of the FR2. The experiment was intended to yield first results on fuel swelling, fission gas release, and fuel/clad compatibility. The as-fabricated gaps between the fuel and clad were chosen extremely small (50, 90 μm rad) so that already at low burnup relevant effects would appear. The fuel pins were irradiated to burnups of about 20, 50, and 70 MWd/kg M at linear rod powers of 800 to 1100 W/cm and clad outer temperatures of 450 to 600°C.

28976 (CONF-800804—3) **Design and testing of CRBRP insulated horizontal and vertical pipe clamps.** Pollono, L.P.; Mello, R.M. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1980. Contract AC15-76CL02395. 40p. NTIS, PC A03/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

The Clinch River Breeder Reactor Plant (CRBRP) Primary Heat Transport system piping may be characterized as large-diameter, thin-wall piping which transports liquid sodium at high temperatures. The piping is arranged in accord with the elevated loop concept, consisting of large horizontal inplane, expansion loops and long, vertical runs of piping. These characteristics and the postulated thermal transient and seismic loads, which are imposed on the piping, dictate pipe clamp designs that are substantially different from standard off the shelf pipe clamp designs. The design features of the CRBRP horizontal and vertical pipe clamps for the large sodium piping, the various test programs used to verify the clamp designs, and the results of this testing are presented.

28977 (GA—15936) **Major GCFR design changes.** Schoene, T.; Hansen, R.; Menzel, H. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 31p. (CONF-800607—61). NTIS, PC A03/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Major design changes have been made to the GCFR concept in the last two years. The changes include (1) change in core flow direction, from downflow to upflow, (2) adoption of natural circulation cooling as an integral part of the residual heat removal (RHR) approach, (3) adoption of a new, independent, safety class, residual heat removal system in addition to the traditional Core Auxiliary Cooling System, (4) elimination of the resuperheater section from the steam generator, and (5) change in the means of driving the main loop helium circulator, from steam drive to electric motor drive.

28978 (HEDL-TME—78-55(Vol.3)) **Computer code for the atomistic simulation of lattice defects and dynamics.** Schiffgens, J.O.; Graves, N.J.; Oster, C.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 207p. NTIS, PC A10/MF A01.

This document has been prepared to satisfy the need for a detailed, up-to-date description of a computer code that can be used to simulate phenomena on an atomistic level. COMENT was written in FORTRAN IV and COMPASS (CDC assembly language) to solve the classical equations of motion for a large number of atoms interacting according to a given force law, and to perform the desired ancillary analysis of the resulting data. COMENT is a dual-purpose intended to describe static defect configurations as well as the detailed motion of atoms in a crystal lattice. It can be used to simulate the effect of temperature, impurities, and pre-existing defects on radiation-induced defect production mechanisms, defect migration, and defect stability.

28979 (ORNL/TM—7100) **Thermal-hydraulic/heat transfer code development for sphere-pac-fueled LMFBRs.** Morris, D.G. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

Sphere-pac fuel has received much attention recently in light of the development of proliferation-resistant fuel cycles for the Fast Breeder Reactor Program in the United States. However, for sphere-pac fuel to be a viable alternative to conventional pellet fuel, a means to analyze the thermal behavior of sphere-pac-fueled pin bundles is needed. To meet this need, a thermal-hydraulic/heat transfer computer code has been developed for sphere-pac-fueled fast breeder reactors. The code, COBRA-3SP, is a modified version of COBRA-3M incorporating a three-region sphere-pac fuel pin model which permits fuel restructuring. With COBRA-3SP, steady-state and transient analysis of sphere-pac-fueled pin bundles is possible. The validity of the sphere-pac fuel pin model has been verified using experimental results of irradiated sphere-pac fuel.

28980 (ORO—6078-2) **Design, implementation and cost-benefit analysis of a dynamic testing program in the Experimental Breeder Reactor-II.** Greene, S.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Mar 1979. Contract AS05-78ET37506. 281p. NTIS, PC A13/MF A01.

Thesis.

Dynamic tests have been performed for many years in commercial pressurized and boiling water reactors. The purpose of this study was to evaluate the technological and economical feasibility of extending the current light water reactor testing procedures to both present and future liquid metal fast breeder reactors. A 38 node linearized, lumped parameter, EBR-II system model was developed. This model was analyzed to obtain the predicted system time and frequency response for reactivity perturbations, intermediate heat exchanger secondary inlet sodium temperature perturbation frequency response, and various system nodal frequency response sensitivities.

28981 **Reasons for opposition to the breeder reactor.** Timbal-Duclaux, L. (Electricite de France, 75 - Paris. Direction de l'Equipement). *Rev. Gen. Nucl.;* No. 6, 668-670(Nov-Dec 1979). (In French).

The author gives a sociological analysis of the opposition to breeder reactors in France, stressing that the antinuclear groups main thrust of protest against the Super-Phenix has dimished since its apex two years ago.

28982 (DOE-tr—123) **Detection of band-limited components in noise signals by surveillance of the auto- and cross-power spectral density.** Ehrhardt, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1979. Translation of KFK—2559, March 1978. 114p. NTIS (US Sales Only), PC A06/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

In technical plants disturbances are possible which generate small narrow-band components in the measured signals. For the detection of these oscillatory signals the observation of the frequency spectra of the measured signals' noise components is particularly advantageous because they produce additional characteristic peaks. In this paper detection systems for the fast detection of suddenly appearing peaks in the power spectral density of noise signals are presented based on auto- and cross-correlation techniques. General criteria were developed to enable the determination of the optimal detection system and its sensitivity for the different problems. Specially auto- and cross-correlation measurements were compared in dependence on the signal coherence.

28983 (DOE-tr—141) **Velocity and turbulence distribution in the wall channel of a rod bundle.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1979. Translation of KFK—2637, July 1978. 85p. NTIS (US Sales Only), PC A05/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

The turbulent flow through a wall subchannel of a rod bundle was investigated experimentally by means of hot-wires and Pitot-tubes. The aim of this investigation was to get experimental information on the transport properties of turbulent flow, especially on the momentum transport. Detailed data were measured of the distributions of the time-mean velocity, the turbulence intensities and, hence, the kinetic energy of turbulence, of the shear stresses in the directions normal and parallel to the walls, and of the wall shear stresses. The pitch-to-diameter ratio of the rods equal to the wall-to-diameter ratio was 1.40, the Reynolds number of this investigation was $Re = 1.94 \cdot 10^4$.

28984 **Nonrefueling liquid-metal fast breeder reactor.** Doncals, R.A.; Paik, N.C.; Varner, S.K.; Rathbun, R.W.; Petras, D.S. (Westinghouse Advanced Reactors Div., Madison, PA). *Trans. Am. Nucl. Soc.;* 33: 445-446(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28985 **Benchmark critical experiment program for 600- to 700-MW(e) LMFBRs.** LeSage, L.G.; Lineberry, M.J.; McFarlane, H.F.; Carpenter, S.G.; Amundson, P.I. (Argonne National Lab., Idaho Falls, ID). *Trans. Am. Nucl. Soc.;* 33: 834-836(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28986 Investigation of composition self-shielding factors for fast reactor analysis. Karbassiafshar, M.; Addae, A.K. (Howard Univ., Washington, DC). *Trans. Am. Nucl. Soc.;* 33: 861-862(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28987 Sensitivity of core power distribution to localized reactivity insertion in heterogeneous LMFBRs. Lam, P.S.K. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 634-636(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28988 Numerical solution of the Fokker-Planck equation. Ghoniem, N.M.; Sharafat, S. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.;* 33: 261-262(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28989 Sodium hydroxide injections into sodium. McKee, J.M.; Smith, F.A.; Koehl, E.R. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 264-265(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28990 Kinetics of solute segregation via drift and defect-solute complexes in irradiated undersaturated alloys. Baron, M. (Westinghouse R and D Center, Pittsburgh, PA). *Trans. Am. Nucl. Soc.;* 33: 265-266(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28991 Externally pressurized thermal creep testing of short lengths of Zircaloy-4 cladding. Selsley, I.A. (Bettis Atomic Power Lab., West Mifflin, PA). *Trans. Am. Nucl. Soc.;* 33: 267-270(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28992 Cladding attack in uranium-plutonium oxide fast reactor fuel pins. Fee, D.C.; Johnson, C.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 285-286(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28993 Modeling the effects of irradiation on the transient failure behavior of fast reactor cladding. Kramer, J.M.; DiMelfi, R.J. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 286-287(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28994 Neutron-induced helium implantation in GCFR cladding. Yamada, H.; Poeppel, R.B.; Sevy, R.H. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 298-299(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28995 Recent shielding experiments at the ORNL tower shielding facility. Bartine, D.E.; Ingersoll, D.T.; Slater, C.O. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 664-665(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28996 Design of the GCFR demonstration plant reactor shielding system. Perkins, R.G.; Rouse, C.A.; Hamilton, C.J. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* 33: 704-705(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28997 New method for analyzing the thermal-hydraulic performance of fuel assemblies with wire-wrapped rods. Masterson, R. (Hanford Engineering Developement Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* 33: 335-337(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

28998 Application of multiple time-step integration method in SSC. Guppy, J.G. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* 33: 340-341(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

REGULATION AND LICENSING

28999 (DOE/EIA—0201/10) Energy policy study. Volume 10. Nuclear power regulation. Nikodem, Z.D.; Reynolds, A.W.; Clark, R.G. (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1980. 259p. NTIS, PC A12/MF A01.

This report examines the programs for regulating the safety, design, and operation of domestic nuclear power plants. The first part of the study describes the Federal and State regulatory procedures. It describes the legal foundations for the Federal licensing process and the associated State regulatory activities. It then analyzes the aspects of these procedures that affect the cost and supply of nuclear-generated electricity. The second part of this study examines the effects of nuclear safety regulations on the planning and construction lead time for nuclear power stations, the cost of nuclear power, and, ultimately, the decision to invest in nuclear power.

29000 (RDT-STATUS—7-80) RDT Standards status report, July 1980. (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). 1980. Contract W-7405-ENG-26. 37p. RSO.

ECONOMICS

29001 Engineering economics in the RPI nuclear engineering curriculum. Becker, M.; Malaviya, B.K. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* 33: 128-129(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29002 Engineering economy for a nuclear engineering program. Hang, D.F. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 129-130(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

FUEL CYCLE

REFER ALSO TO CITATION(S) 29040

29003 (DOE/NE—0001/7F) Nuclear proliferation and civilian nuclear power. Report of the Nonproliferation Alternative Systems Assessment Program. Volume VII. International perspectives. (Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy). Jun 1980. 93p. NTIS, PC A05/MF A01.

The purpose of this volume is to assess the proliferation vulnerabilities of the present deployment of civilian nuclear-power systems within the current nonproliferation regime and, in light of their prospective deployment, to consider technical and institutional measures and alternatives which may contribute to an improved regime in which nuclear power could play a significant part. An assessment of these measures must include consideration of their nonproliferation effectiveness as well as their bearing upon energy security, and their operational, economic, and political implications. The nature of these considerations can provide some measure of their likely acceptability to various nations.

29004 (ORNL/SUB—7494/3) Fuel utilization improvements in a once-through PWR fuel cycle. Final report on Task 6. Dabby, D. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Jun 1979. Contract W-7405-ENG-26. 43p. (WCAP—9547). NTIS, PC A03/MF A01.

In studying the position of the United States Department of Energy, Non-proliferation Alternative Systems Assessment Program, this report determines the uranium saving associated with various improvement concepts applicable to a once-through fuel cycle of a standard four-loop Westinghouse Pressurized Water Reactor. Increased discharged fuel burnup from 33,000 to 45,000 MWD/MTM could achieve a 12% U_3O_8 saving by 1990. Improved fuel management schemes combined with coastdown to 60% power, could result in U_3O_8 savings of 6%.

29005 (ORNL/Sub—7496/2) Fuel utilization improvement in PWRs using the denatured ^{233}U-Th cycle. Jones, H.M.; Schwenk, G.A.; Toops, E.C.; Yotinen, V.O. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Jun 1980. Contract W-7405-ENG-26. 73p. (BAW—1608). NTIS, PC A04/MF A01.

A number of changes in PWR core design and/or operating strategy were evaluated to assess the fuel utilization improvement achievable by their implementation in a PWR using thorium-based fuel and operating in a recycle mode. The reference PWR for this study was identical to the B and W Standard Plant except that the fuel pellets were of denatured (^{233}U/^{238}U-Th)O_2. An initial scoping

study identified the three most promising improvement concepts as (1) a very tight lattice, (2) thorium blankets, and (3) ThO_2 rods placed in available guide tubes. A conceptual core design incorporating these changes was then developed, and the fuel utilization of this modified design was compared with that of the reference case.

29006 Improved uranium utilization: DOE objectives and projects. Lang, P.M. (Dept. of Energy, Washington, DC). *Trans. Am. Nucl. Soc.;* **33**: 389-390(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29007 Historical survey of US LWR fuel utilization. Turner, S.E. (Southern Science Applications, Inc., Dunedin, FL); Elgin, W.J.; Mowery, A.L. *Trans. Am. Nucl. Soc.;* **33**: 390-391(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29008 Development of a fuel management scheme for extended burnup at VEPCO. Bowling, M.L.; Smith, M.L.; Franklin, C.B. (Virginia Electric and Power Co., Richmond). *Trans. Am. Nucl. Soc.;* **33**: 392-393(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29009 Improved fuel management with extended burnup fuels. Coleman, T.A.; Andrews II, J.B.; Worsham III, J.R.; Uotinen, V.O. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.;* **33**: 393-395(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29010 Fuel management schemes for extended fuel burnup in c-e operating reactors. Bachman, W.H.; Beaudreau, J.J.; Lippold, W.J. (Baltimore Gas and Electric Co., MA). *Trans. Am. Nucl. Soc.;* **33**: 395-396(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29011 BWR fuel management improvements for once-through fuel cycles. Crowther, R.L.; Savoia, P.J.; Wei, P.; Wolters, R.A. . (General Electric Co., San Jose, CA). *Trans. Am. Nucl. Soc.;* **33**: 396-397(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29012 Two near-term alternatives to improved nuclear fuel utilization. Macnabb, W.V. (NUS Corp., Rockville, MD). *Trans. Am. Nucl. Soc.;* **33**: 398-399(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29013 Rountine coastdown in LWRs as an ore conservation measure. Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge); Pilat, E.E.; Correa, F. *Trans. Am. Nucl. Soc.;* **33**: 399-400(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29014 Benefits of cycle stretchout in PWR extended burnup fuel cycles. Beekmann, R.W.; Leung, D.C.; Liu, Y.; Matzie, R.A. (Combustion Engineering, Inc., Windsor, CT). *Trans. Am. Nucl. Soc.;* **33**: 400-402(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29015 Comparisons of alternative LWR fuel cycles containing thorium. Heeb, C.M.; Nolan, A.M. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 403-405(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29016 Relative worth of ^{233}U and ^{235}U in thorium-based fuel cycles. Parvez, A.; Ahmad, S.A. (Center for Nuclear Studies, Pinstech, Pakistan). *Trans. Am. Nucl. Soc.;* **33**: 405-406(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29017 Optimization of the MEU fuel cycle for the HTGR. Seth, S.; Brogli, R.H.; Merrill, M.H. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 406-407(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29018 Nuclear fuel management programs and educational requirements. Davis, K.W.; Gumprecht, R.O. (Sargent and Lundy Engineers, Chicago, IL). *Trans. Am. Nucl. Soc.;* **33**: 128(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29019 Approach to fuel management education. Reynolds, R.S. (Mississippi State Univ., MS). *Trans. Am. Nucl. Soc.;* **33**: 130-131(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29020 Simple educational in-core fuel management computer system. Pandey, S. (Nuclear Research Corp., South Hampton, PA); Levine, S.H.; Witzig, W.F. *Trans. Am. Nucl. Soc.;* **33**: 132-133(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

PROCESS HEAT REACTORS

29021 Use of power plant waste heat in district heating systems. Vreeland, D.; Schrock, V. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **33**: 9-10(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 28953, 29001, 29002, 29019, 29020, 29070, 29859

29022 (CONF-800607—36) **Void coefficient in a unit cell for U-Pu water breeder reactors.** Ronen, Y.; Cojocaru, M.; Radkowsky, A. (Oak Ridge National Lab., TN (USA); Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.
From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).
The possibility of breeding with the Pu-U fuel cycle in light or heavy water has been established. For such lattices the void coefficient in a unit cell was calculated. It was found that for light water lattices the void coefficient is negative whereas for heavy water lattices the void coefficient is positive. However, it was shown that by introducing a relatively small amount of light water to the heavy water, a negative void coefficient is obtained while retaining many of the heavy water lattice properties. The results of an investigation of the value of the void coefficient during burnup in a unit cell of the heavy/light water lattices was investigated and the results are presented.

29023 (CONF-800607—57) **Implementation of generalized perturbation theory into the 3-D nodal code SIMULATE.** Bowman, S.M.; Williams, M.L.; Dodds, H.L. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.
From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).
Determining the effects of changes in design and data parameters upon reactor performance can be very expensive when many perturbations must be considered for a complex system. In order to substantially reduce the cost involved in calculations such as these, generalized perturbation theory (GPT) capability has been implemented into the 3-D LWR nodal reactor analysis code SIMULATE. This capability makes 3-D sensitivity analysis of a realistic LWR practical for the first time. Applications to design analysis will be discussed.

29024 Detailed error analysis of average fission cross-section measurements in NBS standard neutron fields. Wagschal, J.J. (Oak Ridge National Lab., TN); Maerker, R.E.; Gilliam, D.M. *Trans. Am. Nucl. Soc.;* **33**: 823-825(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29025 Thermal reactor benchmark calculations with the MCNP Monte Carlo code. Prael, R.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 846-848(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29026 NBS intermediate-energy standard neutron field (ISNF) revisited. Broadhead, B.L. (Univ. of Tennessee, Knoxville); Wags-

chal, J.J. *Trans. Am. Nucl. Soc.;* **33**: 848-849(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29027 Evaluation of integral paramter correlations and reactor performance using nuclear data covariances. Rinaldis, D. (Georgia Inst. of Tech., Atlanta); Kallfelz, J.M.; Kujawski, E.; Marable, J.H. *Trans. Am. Nucl. Soc.;* **33**: 859-860(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29028 Neutron and fuel cycle kinetics analogy. Maudlin, P.J. (Oak Ridge National Lab., TN); Ott, K.O. *Trans. Am. Nucl. Soc.;* **33**: 346-347(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29029 Separation technique and sensitivity theory for hybrid reactor analysis. Youssef, M.Z.; Conn, R.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.;* **33**: 350-351(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29030 Computation of analytical bounds for cross-section self-shielding factors. Barhen, J.; Cacuci, D.G. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 351-353(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29031 Proper use of the Nordheim integral treatment for resonance processing. Pevey, R.E. (Univ. of Tennessee, Knoxville); Dodds, H.L. Jr.; Green, N.M.; Westfall, R.M. *Trans. Am. Nucl. Soc.;* **33**: 353-354(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29032 Multichannel-analyzer/microcomputer system for nuclear laboratory instruction. Wehring, B.W.; Swift, G.M.; Weidenfeld, D. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **33**: 107-108(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29033 Computer-based data acquisition and analysis in a nuclear instrumentation laboratory course. Kaplan, S.N. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **33**: 108(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29034 Desktop calculators in the nuclear radiation detection laboratory. Davidson, J.N. (Georgia Inst. of Tech., Atlanta). *Trans. Am. Nucl. Soc.;* **33**: 108-109(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29035 Modification and utilization of standard microprocessor-based nuclear instrumentation. Binney, S.E. (Oregon State Univ., Corvallis). *Trans. Am. Nucl. Soc.;* **33**: 109-111(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29036 Computer simulation techniques for an undergraduate nuclear physics course. Adler, F.T. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **33**: 111-113(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29037 Use of computer graphics in teaching reactor thermal hydraulics. Gay, R.R.; Aymerich, E. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **33**: 113-116(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29038 Laboratory instructional programs in computer instrumentation at RPI. Bryant, W.A.; Malaviya, B.K. (Rensselaer Polytechnic Inst., Troy, NY). *Trans. Am. Nucl. Soc.;* **33**: 117-118(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29039 Nuclear fuel design. Weisman, J.; Eckart, L. (Univ. of Cincinnati, OH). *Trans. Am. Nucl. Soc.;* **33**: 120-122(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29040 In-core fuel management educational module. Levine, S.H. (Pennsylvania State Univ., University Park). *Trans. Am. Nucl. Soc.;* **33**: 124-126(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29041 Undergraduate energy option. Lucey, J.W. (Univ. of Notre Dame, IN). *Trans. Am. Nucl. Soc.;* **33**: 131(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29042 Nuclear engineering courses for utility and nuclear power careers. Bohannon, J.R. Jr. (North Carolina State Univ., Raleigh). *Trans. Am. Nucl. Soc.;* **33**: 131-132(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29043 Further experience in altering the classical order in the teaching of reactor analysis. Ruby, L.; Schrock, V.E. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **33**: 134(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 29327, 29338, 29339

29044 (CONF-800607—46) **Detection of sensor failures in nuclear plants using analytic redundancy.** Kitamura, M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

A method for on-line, nonperturbative detection and identification of sensor failures in nuclear power plants was studied to determine its feasibility. This method is called analytic redundancy, or functional redundancy. Sensor failure has traditionally been detected by comparing multiple signals from redundant sensors, such as in two-out-of-three logic. In analytic redundancy, with the help of an assumed model of the physical system, the signals from a set of sensors are processed to reproduce the signals from all system sensors.

29045 (EPRI-NP—1407) **Development of ultrasonic tomography for residual stress mapping. Final report.** Boland, A.J.; Davis, T.J.; Doctor, S.R.; Harrington, T.P.; Hildebrand, B.P.; Lemon, D.K.; Posakony, G.J.; Skorpik, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 82p. NTIS, PC A05/MF A01.

The volumetric stress distribution in nuclear reactor piping and pressure vessels is becoming an increasingly important parameter in nondestructive evaluation. This report describes research and development of instrumentation leading toward a means of measuring subsurface stress distributions in metals. Based on the principles of Computerized Tomography (CT), an ultrasonic tomographic instrument system has been developed. The microprocessor-based system uses an ultrasonic linear array to acquire time-of-flight data to an accuracy of 0.5 to 1.0 ns. The data is processed using a modified ART (Algebraic Reconstruction Technique) program. A two-dimensional map of the velocity distribution is displayed on a monitor. The velocity distribution is interpreted or calibrated in terms of stress through the acousto-elastic coefficients.

29046 (UCRL—84079) **Weld evaluation on spherical pressure vessels using holographic interferometry.** Boyd, D.M.; Wilcox, W.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 May 1980. Contract W-7405-ENG-48. 16p. (CONF-800575—2). NTIS, PC A02/MF A01.

From 4. SESA international congress on experimental mechanics; Boston, MA, USA (25 May 1980).

Waist welds on spherical experimental pressure vessels have been evaluated under pressure using holographic interferometry. A coincident viewing and illumination optical configuration coupled with a parabolic mirror was used so that the entire weld region could be examined with a single hologram. Positioning the pressure vessel at the focal point of the parabolic mirror provides a relatively undistorted 360 degree view of the waist weld. Double exposure and real time holography were used to obtain displacement information on the weld region. Results are compared with radiographic and ultrasonic inspections.

29047 Nuclear heating in thick iron slabs at the ORR pool side facility. Siman-Tov, I.I. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 831-832(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29048 Development of an advanced design thermal mixer. Kasza, K.E.; Bobis, J.P. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 606-607(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29049 Behavior of B_4C materials in spent-fuel storage pools. Macmillan, N.H. (Pennsylvania State Univ., University Park); Naum, R.G.; Shaffer, P.T.B. *Trans. Am. Nucl. Soc.;* **33**: 288-290(1979).

FUEL ELEMENTS

29050 Simulation of a 7-pin bundle during a flow-rundown transient. Domanus, H.M.; Chen, M.J.; Sha, W.T. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 630-632(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29051 Basic chemical compatability of uranium carbides with Cr-Fe-Ni alloys. Beahm, E.C.; Culpepper, C.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 262-264(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29052 Asymmetric fuel-cladding gap conductance and fuel pin thermal performance. McNary, O.; Bauer, T.H. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 275-276(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29053 Benchmark rod-bundle thermal-hydraulic analysis using boundary-fitted coordinates. Sha, W.T. (Argonne National Lab., IL); Chen, B.C.J.; Cha, Y.S.; Vanka, S.P.; Schmitt, R.C.; Thompson, J.F.; Doria, M.L. *Trans. Am. Nucl. Soc.;* **33**: 333-335(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

CONTROL SYSTEMS

29054 (HEDL-SA—1984-FP) **Effect of material variables on the irradiation performance of boron carbide.** Basmajian, J.A.; Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 19p. (CONF-800609—6). NTIS, PC A02/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

Boron carbide pellets were fabricated with variations in material parameters. These pellets were irradiated in the Experimental Breeder Reactor-II (EBR-II) to determine the effect of these variations on the performance. Helium release from the material and swelling of the pellets are the primary measures of performance. It was determined that material with a smaller grain size released more helium and swelled less. The pellets with boron-to-carbon ratios greater than 4 to 1 did not perform well. Iron additions improved the performance of the material while density variations had little effect.

29055 (PNL-TR—391) **Safety aspects of fast-reactor core operation.** Gourdon, J.; Penet, F.; Savineau, M. Mar 1980. Translated from IAEA Proceedings Series: IAEA-SM—225/13, pp 159-175. 30p. Dep. NTIS, PC A03/MF A01.

On the basis of Phenix operating experience, a description is presented on how to monitor the main safety parameters of the core without appreciably disturbing the power plant operation, and how to guard against errors of core loading during handling operations. More particularly, it deals with the methods and the results obtained for checking control-rod efficiency and of following the core reactivity and neutron negative feedback factors. It then indicates the preventive measures which are distributed over the handling chain and which were effective in preventing any core-loading error during three years of operation.

29056 Sensitivity of detecting BWR control rod vibrations using neutron noise. Sweeney, F.J. (Oak Ridgy National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 793-794(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29057 Measurements of control rod interactions in ZPPR-9. McFarlane, H.F.; Collins, P.J. (Argonne National Lab., Idaho Falls, ID). *Trans. Am. Nucl. Soc.;* **33**: 832-834(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29058 DOE man-machine interaction program. Norin, M.P. (U.S. Department of Energy, Washington, DC); Dahlgren, D.A. *Trans. Am. Nucl. Soc.;* **33**: 556(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 29149

29059 Treatment of operator actions in the HTGR risk assessment study. Fleming, K.N.; Silady, F.A.; Hannaman, G.W. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 566-567(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SITING

29060 Multiobjective regional energy location model: cost versus population proximity trade-offs. Eagles, T.; Margulies, T.; Cohon, J.; ReVelle, C. (Johns Hopkins Univ., Laurel, MD). *Trans. Am. Nucl. Soc.;* **33**: 613-614(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29061 Evaluation and comparison of high population density sites. Margulies, T.S. (Johns Hopkins Univ., Laurel, MD). *Trans. Am. Nucl. Soc.;* **33**: 615-617(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29062 Verbal rating of alternative sites using fuzzy multiple-criteria weights. Kenrangui, R.; Husseiny, A.A.; Daniels, K. (Science Applications, Inc., Ames, IA). *Trans. Am. Nucl. Soc.;* **33**: 617-619(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

RADIOACTIVE EFFLUENTS

29063 (SAND—80-0366) **Observations on the use of the consequence model CRAC for small nonreactor atmospheric releases.** Ericson, D.M. Jr. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01.

As part of the Reactor Safety Study, a consequence model, CRAC, was developed to examine the public consequences of accidental releases of radioactive material from nuclear power plants. Since the development of the model, several studies have been conducted to examine the sensitivity of the model to factors such as plume rise, wind shear, rain, and population evacuation. All of these studies were performed assuming one or more of the potentially large accidental releases from reactor sites. At the same time, CRAC has been used to examine the consequences of sabotage-caused releases from spent fuel during transport. In the most recent study, the consequence estimates obtained with CRAC were compared with those obtained using METRAN, the consequence model developed for the Urban Study.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 28955, 28985, 29079, 29087, 29089, 29092, 29105, 29108, 29109, 29111, 29118, 29120, 29121, 29125, 29138, 29143, 29145, 29565

29064 (CONF-800607—45) **S/sub n/ transport calculations of the PCA experiments with some estimated uncertainties.** Maerker, R.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Detailed flux calculations have been carried out for both the 8/7 and 12/13 configurations involving the Pool Critical Assembly (PCA) at Oak Ridge. In addition, estimates of uncertainties in the calculations arising from both methods approximations and input

data uncertainties for two important detector locations in the 8/7 configuration have been made.

29065 (EGG-LO-MR—007) **LOFT monthly progress report, May 1980.** Kaufman, N.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1980. Contract AC07-76ID01570. 118p. NTIS, PC A06/MF A01.

On May 29, 1980, the fifth in a series of nuclear experiments was conducted. The experiment, designated L6-5, simulated events which would follow a loss-of-feedwater to all of the steam generators of a large commercial nuclear powered reactor system. Initial results from the experiment indicate that all significant events occurred as expected. In addition to conducting Test L6-5, preparations continued for the next small-break test, L3-7. Currently, efforts for that test are ahead of schedule and targeted for 6/19/80. Costs to date are in good agreement with current budgets and authorized funding levels.

29066 (EGG-LO-OO—80-118) **Experimental data report for transient flow calibration facility tests IIIA101, IIIA102, IIIA201, and IIIA202.** Wambach, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 26 Mar 1980. Contract AC07-76ID01570. 120p. NTIS, PC A06/MF A01.

Thermal-hydraulic response data are presented for the transient performance tests of an ECC pitot tube rake (IIIA201, IIIA202) and both an ECC pitot tube rake and modular drag disc-turbine transducer (DTT) rake (IIIA101, IIIA102). The tests were conducted in a system which provided full scale simulation of the pressure vessel and intact loop cold leg piping of the Loss of Fluid Test Facility (LOFT). A load cell system was used to provide a reference mass flow rate measurement.

29067 (ORO—6078-1) **Cost/benefit analysis for dynamic testing in the Fast Flux Test Facility.** Huynh, Q.A. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Jun 1978. Contract AS05-78ET37506. 345p. NTIS, PC A15/MF A01.

Thesis.

Dynamic tests are being considered for the Fast Flux Test Facility (FFTF). The assembly of a mathematical model, parameter sensitivity studies, planning the dynamic tests, and the estimation of the cost for the tests were performed. Models were developed with different treatments of the fuel heat transfer. Different representations of the reactivity feedback effects were formulated. The models were used to compute time responses and frequency responses for FFTF. The model has also been used to assess the sensitivity of the response to the values used for important system parameters.

29068 **Effects of simulated hodoscope slots in the STF critical assembly.** Robinson, W.R.; Dilorio, G.J. (Argonne National Lab., Idaho Falls, ID). *Trans. Am. Nucl. Soc.;* **33**: 836-838(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29069 **Worth and reaction rate calculations in the STF 3/4 critical assembly.** Schaefer, R.W.; Bucher, R.G.; Morman, J.A. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 849-851(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29070 **Reaction rate and neutron energy spectrum measurements in the FBBF.** Harms, G.A.; Vehar, D.W.; Clikeman, F.M.; Johnson, R.H.; Borg, R.C.; Ott, K.O. (Purdue Univ., West Lafayette, IN). *Trans. Am. Nucl. Soc.;* **33**: 851-852(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29071 **Development of an instrumented materials irradiation test for FFTF.** Grover, J.M.; Kaulitz, D.C.; Krogness, J.C. (Hanford Engineering Development Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 267(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29072 **Low-enriched TRIGA fuel water-quench safety tests.** Lindgren, J.R.; Simnad, M.T. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* **33**: 276-277(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29073 **In-reactor deformation and fracture behavior of EBR-II driver fuel cladding.** Einziger, R.E. (Argonne National Lab., Idaho Falls, ID); Porter, D.L.; Seidel, B.R.; Hofman, G.L. *Trans. Am. Nucl. Soc.;* **33**: 284-285(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29074 **Thermal bowing of wire-wrapped fuel pins in the fast test reactor.** Chan, D.P.; Jackson, R.J. (Hanford Engineering Development Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 287-288(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29075 **Neutron spectroscopy using miniature detectors and preamplifiers.** Vehar, D.W.; Clikeman, F.M.; Johnson, R.H. (Purdue Univ., West Lafayette, IN). *Trans. Am. Nucl. Soc.;* **33**: 697-698(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29076 **Microprocessor-based reactimeter enhances nuclear engineering laboratory class.** Stone, R.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Trans. Am. Nucl. Soc.;* **33**: 116-117(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

29077 **Experimental programs at the Hanford N reactor in support of spent-fuel storage.** Toffer, H. (UNC Nuclear Industries, Inc., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 366-367(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

REACTOR SAFETY

29078 (ALO—85) **Review of literature on the TMI accident and correlation to the LWR Safety Technology Program.** Miller, W.J. (Science Applications, Inc., Monroeville, PA (USA)). May 1980. Contract AC04-76DP00789. 220p. (SAI—124-79-PGH). NTIS, PC A10/MF A01.

This report is the result of approximately two man-months of effort devoted to assimilating and comprehending significant publicly available material related to Three Mile Island Unit 2 and events during and subsequent to the accident experienced on March 28, 1979. Those events were then correlated with the Preliminary LWR Safety Technology Program Plan (Preliminary Program Plan) prepared for the US Department of Energy by Sandia National Lab. This report is being submitted simultaneously with the SAI report entitled Preliminary Prioritization of Tasks in the Draft LWR Safety Technology Program Plan.

29079 (CONF-800542—4) **Explosive demolition of activated concrete.** Smith, D.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 16p. NTIS, PC A02/MF A01.

From Concrete decontamination workshop; Seattle, WA, USA (28 May 1980).

This paper describes the removal of a radiologically contaminated concrete pad. This pad was removed during 1979 by operating personnel under the direction of the Waste Management Program of EG and G Idaho, Inc. The concrete pad was the foundation for the Organic Moderated Reactor Experiment (OMRE) reactor vessel located at the Idaho National Engineering Laboratory (INEL). The pad consisted of a cylindrical concrete slab 15 ft in diameter, 2 ft thick, and reinforced with steel bar. It was poured directly onto basalt rocks approximately 20 ft below grade. The entire pad contained induced radioactivity and was therefore demolished, boxed, and buried rather than being decontaminated. The pad was demolished by explosive blasting.

29080 (CONF-800607—48) **Appliction of sensitivity theory for extrema of functionals to a transient reactor thermal-hydraulics problem.** Cacuci, D.G.; Weber, C.F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

A generalized sensitivity theory based on adjoint functions has been recently developed for systems governed by coupled nonlinear equations and nonlinear responses, and has been successfully applied to several reactor thermal-hydraulics sample problems. This theory has now been significantly extended to include treatment of a new class of responses which are extrema (in phase-space variables) of functionals of the system's state vector and input parameters. Examples of such responses - of great interest in reactor safety and design - are the maximum clad and maximum fuel temperatures. A practical application of this theory is presented.

29081 (CONF-800607—51) **Determination of incipient boiling propagation from tests in a simulated LMFBR assembly.** Klein, G.A.;

Haga, K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Two-dimensional boiling effects may significantly influence the course of LOPI and LSHRS hypothetical accident sequences. Boiling models are being developed at ANL and MIT to investigate conditions under which these two-dimensional effects are important. A thermocouple correlation technique has been developed at ORNL to track the void growth in sodium tests run in the Thermal-Hydraulic Out-of-Reactor Safety (THORS) facility. This information can be used to aid in the development and verification of the constitutive relations required by the multi-dimensional codes.

29082 (CONF-800723—7) **Comparison of measured and calculated LWR fuel behavior during a hypothetical reactivity initiated accident.** Fukuda, S.K.; MacDonald, P.E.; Garner, R.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 37p. NTIS, PC A03/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

Comparisons of measured and calculated LWR fuel rod responses during a reactivity initiated accident test are presented. The results indicate that the computer code, FRAP-T5, adequately calculates the fuel rod behavior up to the time at which the gap closes and provides a good thermal solution up to the time of gross fuel and cladding relocation. Three areas have been identified for further model development: (a) development of a fuel swelling model for near molten fuel temperatures; (b) incorporation of a deformable fuel pellet model that is applicable for the closed gap, high strain rate regime; and (c) expansion of the failure stress data base to include heat-up rates of up to 5000 K/s.

29083 (CONF-800723—15) **Improved guidelines for RELAP4/MOD6 reflood calculations.** Chen, T.H.; Fletcher, C.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 33p. NTIS, PC A03/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

Computer simulations were performed for an extensive selection of forced- and gravity-feed reflood experiments. This effort was a portion of the assessment procedure for the RELAP4/MOD6 thermal hydraulic computer code. A common set of guidelines, based on recommendations from the code developers, was used in determining the model and user-selected input options for each calculation. The comparison of code-calculated and experimental data was then used to assess the capability of the RELAP4/MOD6 code to model the reflood phenomena. As a result of the assessment, the guidelines for determining the user-selected input options were improved.

29084 (CONF-800723—16) **Analysis of molten debris freezing and wall erosion during a severe RIA test.** El-Genk, M.S.; Moore, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 33p. NTIS, PC A03/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

A one-dimensional physical model was developed to study the transient freezing of the molten debris layer (a mixture of UO_2 fuel and zircaloy cladding) produced in a severe reactivity initiated accident in-pile test and deposited on the inner surface of the test shroud wall. The wall had a finite thickness and was cooled along its outer surface by coolant bypass flow. Analyzed are the effects of debris temperature, radiation cooling at the debris layer surface, zircaloy volume ratio within the debris, and initial wall temperature on the transient freezing of the debris layer and the potential melting of the wall. The governing equations of this two-component, simultaneous freezing and melting problem in a finite geometry were solved using a one-dimensional finite element code based on the method of weighted residuals.

29085 (CONF-800804—7) **Centrifugal pump performance under simulated two-phase flow conditions.** Chen, T.H.; Quapp, W.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 28p. NTIS, PC A03/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Test results are presented from centrifugal (mixed-flow) pump performance testing conducted at the Idaho National Engineering Laboratory (INEL) using nitrogen-water flow to simulate steam-water two-phase conditions. The results are compared with the predictions of the RELAP4/MOD6 pump performance model which is based on experimental data obtained from tests conducted on a small (radial-flow) pump in the Semiscale facility. The purpose of this investigation is to obtain the two-phase characteristics of a mixed-flow pump and evaluate the prediction capability of the pump model commonly used to analyze the thermal-hydraulic response when applied to a postulated loss-of-coolant accident in a light water reactor.

29086 (DOE/ER/01359—T1) **Nuclear safety code study. Final report.** Jackson, C.; Abumansoor, K.; Myers, E.; Jespersen, D.; Cramer, E.; O'Reilly, B.; Carmichael, B. (Harvey Mudd Coll., Claremont, CA (USA)). Jun 1980. Contract AS03-77ER01359. 165p. NTIS, PC A08/MF A01.

An unprotected overpower accident in a Liquid Metal Fast Breeder Reactor is studied. A mathematical model and a system of partial differential equations for the temperature are derived. After spatial discretization, a large system of ordinary differential equations is obtained. The steady state version of the equations is solved analytically.

29087 (EGG-LO—87-80-130) **Special LOFT features for improved monitoring and survival of LOCA transients.** Goodrich, L.D.; Leach, L.P.; Klingler, T.B.; Morrow, J.C.; Phoenix, W.C.; Satterwhite, D.G.; Sumpter, K.C.; Rouhani, S.Z.; Welland, H.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 7 Jan 1980. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01.

LOFT is designed to monitor and survive Loss-Of-Coolant-Accidents (LOCAs). This report presents the primary design difference from LPWRs that were required to accomplish this. These design differences may be of interest to the nuclear power generator industry. This report should be revised semi-annually or as developments in the LOFT Program require.

29088 (GA-A—15439) **Licensing topical report: the measurement and modelling of time-dependent fission product release from failed HTGR fuel particles under accident conditions.** Myers, B.F.; Morrissey, R.E. (General Atomic Co., San Diego, CA (USA)). Apr 1980. Contract AT03-76ET35300. 153p. NTIS, PC A08/MF A01.

The release of fission products from failed fuel particles was measured under simulated accident (core heatup) conditions. A generic model and specific model parameters that describe delayed fission product release from the kernels of failed HTGR fuel particles were developed from the experimental results. The release of fission products was measured from laser-failed BISO ThO_2 and highly enriched (HEU) TRISO UC_2 particles that had been irradiated to a range of kernel burnups. The burnups were 0.25, 1.4, and 15.7% FIMA for ThO_2 particles and 23.5 and 74% FIMA for UC_2 particles. The fission products measured were nuclides of xenon, iodine, krypton, tellurium, and cesium.

29089 (HEDL-SA—1966-FP) **Sodium Loop Safety Facility W-2 experiment fuel pin rupture detection system.** Hoffman, M.A.; Kirchner, T.L.; Meyers, S.C. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1980. Contract AC14-76FF02170. 28p. (CONF-800607—67). NTIS, PC A03/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The objective of the Sodium Loop Safety Facility (SLSF) W-2 experiment is to characterize the combined effects of a preconditioned full-length fuel column and slow transient overpower (TOP) conditions on breeder reactor (BR) fuel pin cladding failures. The W-2 experiment will meet this objective by providing data in two technological areas: (1) time and location of cladding failure, and (2) early post-failure test fuel behavior. The test involves a seven pin, prototypic full-length fast test reactor (FTR) fuel pin bundle which will be subjected to a simulated unprotected 5 cents/s reactivity transient overpower event. The outer six pins will provide the necessary prototypic thermal-hydraulic environment for the center pin.

29090 (HEDL-SA—2015-FP) **W-1 Sodium Loop Safety Facility experiment centerline fuel thermocouple performance.** Meyers, S.C.; Henderson, J.M. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1980. Contract AC14-76FF02170. 51p. (CONF-800607—65). NTIS, PC A04/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

The W-1 Sodium Loop Safety Facility (SLSF) experiment is the fifth in a series of experiments sponsored by the Department of Energy (DOE) as part of the National Fast Breeder Reactor (FBR) Safety Assurance Program. The experiments are being conducted under the direction of Argonne National Laboratory (ANL) and Hanford Engineering Development Laboratory (HEDL). The irradiation phase of the W-1 SLSF experiment was conducted between May 27 and July 20, 1979, and terminated with incipient fuel pin cladding failure during the final boiling transient. Experimental hardware and facility performed as designed, allowing completion of all planned tests and test objectives. This paper focuses on high temperature in-fuel thermocouples and discusses their development, fabrication, and performance in the W-1 experiment.

29091 (LA-UR—79-3301) **System calculations related to the accident at Three-Mile Island using TRAC.** Ireland, J.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800723—12). NTIS, PC A02/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

The Three Mile Island nuclear plant (Unit 2) was modeled using the Transient Reactor Analysis Code (TRAC-P1A) and a base case calculation, which simulated the initial part of the accident that occurred on March 28, 1979, was performed. In addition to the base case calculation, several parametric calculations were performed in which a single hypothetical change was made in the system conditions, such as assuming the high pressure injection (HPI) system operated as designed rather than as in the accident. Some of the important system parameter comparisons for the base case as well as some of the parametric case results are presented.

29092 (ORAU/IEA—80-7(M)) **Common mode failure of light water reactor systems: what has been learned.** Epler, E.P. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). May 1980. Contract AC05-76OR00033. 45p. NTIS, PC A03/MF A01.

During the reactor development period it was found that the failure of protection and the demand for protection were sometimes concurrent. Design errors or operator error, usually in conducting tests or in performing maintenance operations, were the cause of several core melt events. These experiences of one-of-a-kind reactors were believed not to apply to light water reactors (LWRs); however, the examination of several systemic failures shows that these failure mechanisms persist.

29093 (SAND—80-0679(Pt.1)) **Identification of the impacts of maintenance & testing upon the safety of LWR power plants. Final report.** Husseiny, A.A.; Sabri, Z.A.; Turnage, J.J. (Science Applications, Inc., Ames, IA (USA)). Apr 1980. Contract AC04-76DP00789. 178p. (ALO—77/1; SAI—100-81-AM(Pt.1)). NTIS, PC A09/MF A01.

The present study was designed to identify the impact of maintenance and testing (M & T) upon the safety of LWR power plants. The study involved data extraction from various sources reporting safety-related and operation-related nuclear power plant experience. Primary sources reviewed, including Licensee Event Reports (LER's) submitted to the NRC, revealed that only ten percent of events reported could be identified as M & T problems. The collected data were collated in a manner that would allow identification of principal types of problems which are associated with the performance of M & T tasks in LWR power plants. Frequencies of occurrence of events and their general endemic nature were analyzed using data clustering and pattern recognition techniques, as well as chi-square analyses for sparse contingency tables. The results of these analyses identified seven major categories of M & T error modes which were related to individual facilities and reactor type. Data review indicated that few M & T problems were directly related to procedural inadequacies, with the majority of events being attributable to human error.

29094 (SAND—80-1066) **Light Water Reactor Safety Technology Program. Quarterly report, October-December 1979.** (Sandia National Labs., Albuquerque, NM (USA)). Jun 1980. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01.

Information on LWR safety is presented concerning the Technology Management Center support programs; risk methods utilization; improved safety systems;man-machine interaction; safety data; and progress reports for each of the research project areas.

29095 Heat transfer and thermal losses in above-core regions. Bell, C.R.; Boudreau, J.E. (Los Alamos Scientific Lab., NM (USA). Energy Div.). *Nucl. Eng. Des.;* **55**: No. 2, 185-195(Dec 1979).

From 5. international conference on structural mechanics in reactor technology (SMIRT-5) and 9. international seminar in conjunction with 2. international seminar on structural reliability of mechanical components and subassemblies of nuclear power plants and 2. international seminar on containment of fast breeder reactors; Berlin, Germany, F.R. (9 - 21 Aug 1979).

Heat transfer and thermal in above-core regions can substantially influence the conversion of thermal energy to damage potential following postulated core-disruptive accidents in a liquid metal fast breeder reactor. Any assessment of these influences is complex and difficult to substantiate because of the transient, interactive environment in which they occur. This paper develops a perspective for the role of heat-transfer processes in the context of fluid-structure dynamics, containment strength, accident severity, sodium involvement, and uncertainties in current knowledge. The Clinch River Breeder Reactor (CRBR) is used as an example to quantify this perspective. Containment limits are estimated for CRBR to allow a comparative evaluation of the containment tolerance as different physical effects are considered. For a conservative estimate of containment failure threshold and for neutronic excursions resulting in fuel-vapor expansions, the CRBR system tolerance for energetic accidents increases if we include the effects of fluid-structure dynamics and coupled fluid dynamics and heat transfer. Further, additional accommodation for greater sodium involvement (work-potential augmentation) is possible if all heat-transfer processes are considered together. This perspective can contribute valuable insight as decisions are made to reduce the uncertainty in the risk to the public by menas of improved analysis of the energetics problem.

29096 ^{239}Pu decay-heat evaluation. Schmittroth, F.; Schenter, R.E. (Hanford Engineering Development Lab., Richmond, VA). *Trans. Am. Nucl. Soc.;* **33**: 825(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29097 Recriticality due to clad-free pellet rear-rangement in a PWR. Cokinos, D.; Diamond, D.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 844-845(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29098 Boiling water reactor licensing basis transient. Lu, M.S. (Brookhaven National Lab., Upton, NY); Cheng, H.S.; Shier, W.G.; Diamond, D.J.; Levine, M.M.; Odar, F.; Fieno, D. *Trans. Am. Nucl. Soc.;* **33**: 473-474(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29099 Effect of thermal-hydraulic feedback on the BWR rod drop accident. Cheng, H.S.; Diamond, D.J. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 474-476(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29100 Critical power ratio in BWR transient analyses. Lu, M.S.; Shier, W.G.; Levine, M.M. (Brookhaven National Lab., Upton, NY). *Trans. Am. Nucl. Soc.;* **33**: 476-477(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29101 Prediction of critical heat flux during flow transients. Leung, J.C.M.; Gallivan, K.A.; Henry, R.E. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 477-479(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29102 Behavior of a nine-rod PWR bundle under power-cooling-mismatch conditions. Gunnerson, F.S.; Sparks, D.T. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 479-481(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29103 Selected plant transients and steam generator tube rupture with steamline break utilizing the IRT code. Shier, W.G. (Brookhaven National Lab., Upton, NY); Levine, M.M.; Albright, D.C. *Trans. Am. Nucl. Soc.;* **33**: 481-482(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29104 PWR overpower detection for control element assembly ejection transients. Parks, T.R. (Combustion Engineering, Inc., Windsor, CT); Siska, D.P.; Mason, J.H. *Trans. Am. Nucl. Soc.;* **33**: 482-484(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29105 Carryover rate fraction correlation for LOFT safety analysis calculations. Lin, J.C.; White, J.R. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* **33**: 487-488(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29106 Droplet cross-flow phenomena in an LPWR upper plenum. Dallman, J.C.; Kirchner, W.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 488-489(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29107 TRAC-P1A analysis of standard problem. Meier, J.K. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 489-490(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29108 TRAC pre-test calculations of LOFT nuclear test L2-3. Mandell, D.A.; Peterson, A.C.; Williams, K.A.; Creel, J.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 490-491(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29109 Post-test analysis of LOFT LOCE L2-3 using the ESA RELAP4 blowdown model. Perryman, J.L.; Samuels, T.K.; Cooper,

C.H. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* 33: 491-493(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29110 Assessment of the RELAP4/MOD6 reactor transient thermal-hydraulic code. Haigh, W.S.; Charlton, T.R.; Dearien, J.A. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* 33: 493-494(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29111 Blowdown hydraulic influence on core thermal response n LOFT nuclear experiment L2-3. Reeder, D.L. (EG & G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* 33: 494-495(1979). (CONF-791103—).
From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29112 Local heat transfer coefficients in containments after a LOCA. Carbajo, J.J.; Leung, D.M. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 500-502(1979). (CONF-791103—).
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From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

ENERGY STORAGE

COMPRESSED GAS

29155 Air ejector augmented compressed air energy storage system. Ahrens, F.W.; Kartsounes, G.T. US Patent Application 016,036. [nd]. 12p.

Energy is stored in slack demand periods by charging a plurality of underground reservoirs with air to the same peak storage pressure, during peak demand periods throttling the air from one storage reservoir into a gas turbine system at a constant inlet pressure until the air presure in the reservoir falls to said constant inlet pressure, thereupon permitting air in a second reservoir to flow into said gas turbine system while drawing air from the first reservoir through a variable geometry air ejector and adjusting said variable geometry air ejector, said air flow being essentially at the constant inlet pressure of the gas turbine system.

29156 Compressed air energy storage system. Ahrens, F.W.; Kartsounes, G.T. US Patent Application 039,412. [nd]. 23p.

An internal combustion reciprocating engine is operable as a compressor during slack demand periods utilizing excess power from a power grid to charge air into an air storage reservoir and as an expander during peak demand periods to feed power into the power grid utilizing air obtained from the air storage reservoir together with combustion reciprocating engine is operated at high pressure and a low pressure turbine and compressor are also employed for air compression and power generation.

29157 (EPRI-EM—1289) Technical and economic assessment of advanced compressed air storage (ACAS) concepts. Final report. Glendenning, I.; Chew, P.E.; Grant, R.; Glanville, R.; Moye, M.H. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). Dec 1979. 518p. NTIS, PC A22/MF A01.

A study is described of advanced compressed air storage (ACAS) concepts in which oil consumption is reduced or eliminated by thermal storage (TES) or coal substitution. The objectives have been to screen a large number of possible cycle and rank the more promising examples by cost and economic benefit to utilities and with particular emphasis on minimizing development requirements. A near-term hybrid ACAS, using TES, has been identified which is capable of reducing CAS turbine fuel consumption by at least 30% using equipment very closely related to state-of-the-art CAS of conventional design. Such schemes will be economically preferred when either fuel oil costs escalate sufficiently or oil is substituted by synthetic coal-liquids or gases. Economics do not appear to justify substitution of coal for premium fuel through use of integrated gasifier or fluidized bed CAS cycles. The near-term hybrid ACAS is a logical step for CAS development beyond Huntorf, through second generation cycles with recuperators, to cycles that may approach adiabatic CAS (using no turbine fuel). Full adiabatic CAS does not appear feasible in unit sizes which would be attractive to

utilities or equipment vendors, but the economic attractiveness of both conventional CAS and, in longer term, hybrid ACAS is clearly indicated.

FLYWHEELS

29158 Apparatus for utilizing natural energies. Wiedemann, H.O. (to Messerschmitt-Boelkow-Blohm Gesellschaft mit beschraenkter). US Patent 4,159,427. 26 Jun 1979. Priority date 23 Dec 1975, German, Federal Republic of (F.R. Germany), 20p.

An apparatus which stores natural energies available on and/or under the surface of the world's ocean is described. Such energies include solar energy, wave energy, wind energy, as well as energy stored in the heat of the sea water. The energy extracting and storing equipment is installed on a floating vessel or raft. The energy storing equipment includes flywheel type rollers or cylinders driven by electric motors energized by electric generators which in turn receive their energy from the energy extracting equipment. The flywheel type rollers or cylinders include a supporting hollow cylinder having a relatively thin wall onto which there are wound fibers impregnated or embedded in a synthetic resin.

THERMAL

REFER ALSO TO CITATION(S) 28715, 28823, 28824, 28825, 28826, 28827, 28828, 28829, 28830, 28832, 28833, 28834, 28835, 28836

29159 (CONF-791232—, pp 601-606) **Hot-water aquifer storage: a field test.** Parr, A.D.; Molz, F.J.; Andersen, P.F. (Auburn Univ., AL). 1979.

From Thermal energy storage review meeting; Tysons Corner, VA, USA (3 Dec 1979).

The storage of hot water in aquifers is considered one of the most promising near-term alternatives for seasonal storage of thermal energy. Excess heat produced during the summer could be stored in groundwater regions and pumped out during the winter months when demand for heat is greatest. The insulating properties of the earth and the vast volumetric capacity of its aquifers make this concept particularly attractive. Auburn University has been involved in a large-scale field study of heat storage in a confined aquifer near Mobile, Alabama. Currently, two injection-storage-recovery cycles have been completed. The first cycle involved the injection of 54,800 m^3 of 55°C water into the confined aquifer. The ambient temperature of the water in the confined aquifer and in the upper semi-confined aquifer from which the supply water is pumped was 20°C. After a storage period of 51 d, the injection well was pumped until the temperature of the recovered water dropped to 33°C. At that point 55,300 m^3 of water had been withdrawn and 66% of the injected energy had been recovered. A volume of 58,000 m^3 of 55°C water was injected during the second cycle. The water was stored for 63 d and then recovered. When the recovery temperature equalled the temperature at the end of the recovery period for the first cycle, 33°C, 66,400 m^3 had been pumped from the aquifer and 76% of the injected energy had been recovered. The recovery period for the second cycle continued until the water temperature was 27.5°C and 100,100 m^3 of water was recovered. At the end of the cycle about 90% of the energy injected during the cycle had been recovered.

29160 (DOE/NASA/1034—8) **Thermal energy storage. Annual report, January 1979-March 1980.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-77ET26945. 78p. (NASA-TM—81514). NTIS, PC A05/MF A01.

The DOE Division of Energy Storage Systems (DOE/STOR) is responsible for formulating and managing research and development in energy storage technology. Major responsibility for project management in selected areas has been shifted to the DOE national laboratories and other government agencies. NASA Lewis Research Center (LeRC) was given the primary responsibility for the development of high-temperature sensible and latent heat storage technology via Interagency Agreement EC-77-A31-1034. This report describes not only the planning/implementation of activities associated with an acting lead center management role but also the technical accomplishments pertaining to high temperature thermal energy storage subsystems. Major elements reported are: 1.0 Program Definition and Assessment, 2.0 Research and Technology Development, 3.0 Industrial Storage Applications, 4.0 Solar Thermal Power Storage Applications, and 5.0 Building Heating and Cooling Applications.

CHEMICAL

REFER ALSO TO CITATION(S) 28559

BATTERIES

REFER ALSO TO CITATION(S) 29275, 29276

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 29163

29161 (EPRI-EM—1417) **Development of the zinc-chloride battery for utility applications. Work period: April 1, 1978-March 31, 1980.** (Energy Development Associates, Madison Heights, MI (USA)). May 1980. 407p. NTIS, PC A18/MF A01.

Significant accomplishments in the research and development programs during Phase II of the Zn/Cl_2 battery development project were as follows: development of a data base on the density, conductivity, viscosity, chlorine solubility, and the zinc transference number for $ZnCl_2$-KCl-NaCl electrolytes; development of a model describing the hydrodynamic phenomena occurring between individual zinc and chlorine electrodes during charge; demonstration of cell electrochemical energy efficiencies of 74% for delivered capacity densities of 500 Wh/cm^2; completion of reliability studies for 100-MWh battery plants that discuss quantitatively plant availability and electricity cost in terms of module-failure rate; invention of a module-bypass switch concept that isolates a failed module in a series-connected string and thereby avoids string outage; development of a computer model for module operation that allows prediction of the effects of component changes on module performance; and accumulation of 1250 cycles - 50% of the target for battery-stack life - on a 1.7-kWh system with negligible performance degradation. 294 figures, 99 tables.

PERFORMANCE AND TESTING

29162 (DOE/ET/25405—1) **Chlorine hazard evaluation for the zinc-chlorine electric vehicle battery. Final technical report.** Zalosh, R.G.; Bajpai, S.N.; Short, T.P.; Tsui, R.K. (Factory Mutual Research Corp., Norwood, MA (USA)). Apr 1980. Contract AC02-78ET25405. 167p. NTIS, PC A08/MF A01.

Hazards associated with conceivable accidental chlorine releases from zinc-chlorine electric vehicle batteries are evaluated. Since commercial batteries are not yet available, this hazard assessment is based on both theoretical chlorine dispersion models and small-scale and large-scale spill tests with chlorine hydrate (which is the form of chlorine storage in the charged battery). Six spill tests involving the chlorine hydrate equivalent of a 50-kWh battery indicate that the danger zone in which chlorine vapor concentrations intermittently exceed 100 ppM extends at least 23 m directly downwind of a spill onto a warm (30 to 38°C) road surface. Other accidental chlorine release scenarios may also cause some distress, but are not expected to produce the type of life-threatening chlorine exposures that can result from large hydrate spills. Chlorine concentration data from the hydrate spill tests compare favorably with calculations based on a quasi-steady area source dispersion model and empirical estimates of the hydrate decomposition rate. The theoretical dispersion model was combined with assumed hydrate spill probabilities and current motor vehicle accident statistics in order to project expected chlorine-induced fatality rates. These calculations indicate that expected chlorine fatality rates are several times higher in a city such as Los Angeles with a warm and calm climate than in a colder and windier city such as Boston. Calculated chlorine-induced fatality rate projections for various climates are presented as a function of hydrate spill probability in order to illustrate the degree of vehicle/battery crashworthiness required to maintain chlorine-induced fatality rates below current vehicle fatality rates due to fires and asphyxiations. 37 figures, 19 tables.

29163 (LMSC-D—681417) **Basic studies on nickel-zinc batteries. Final report, September 29, 1978-November 28, 1979.** Katan, T.; Bergeron, P.J. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 1979. Contract EM-78-C-01-5165. 127p. NTIS, PC A07/MF A01.

Experiments were conducted with an especially constructed, single-pore electrode designed to examine transport and electrochemical processes. Both the zinc and nickel electrodes were studied with the analog pore having an electrode-electrolyte spacing of only 20 μm. The primary goal was to provide information for nickel-zinc battery development. In situ and postmortem microscopic examinations were conducted to identify surface structural changes in terms of the influence of local current density gradations that arise under the diffusional limitations in small pores. With the zinc electrode, four major phenomena were examined that could possibly develop in commercial Ni-Zn cells: under discharge, four separate reaction fronts were found to move into the pore with 10M KOH, saturated

ZnO in the following order: a front marked by the dissolution of zinc, a precipitation of gray ZnO, precipitation of black ZnO, and a solution of ZnO. Zinc dendrite growth was always found to be preceded by hydrogen gas formation under conditions of galvanostatic charging. Movement of zinc fragments by an electrochemical displacement was found to occur toward the anode at about 2×10^{-4} cm s^{-1} at 1000 mA cm^{-2}. After severe electrolysis between two zinc electrodes, spontaneous growth of mossy zinc occurred at open circuit on the electrode that had previously been the cathode. This process can be identified with perturbations of the hydroxide ion concentration in the pore. With the nickel electrode, exfoliation of the reactive layer on the nickel could be seen after dismantling single-pore cells after 150 cycles. After the 40th cycle, during a prolonged cycling to 150 cyles, a change in the discharge slope was noted, which remained the same thereafter. At the same time, a loss in capacity occurred. 37 figures, 4 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 29277

ENERGY MANAGEMENT AND POLICY

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 29215, 29225, 29232

29164 (DOE/IA—0010) **International energy indicators.** (Department of Energy, Washington, DC (USA). Office of Current Reporting). Jun 1980. 40p. NTIS, PC A03/MF A01.

Data are presented in graphs and tables on the following: Iran: crude oil capacity, production, and shut-in, monthly, June 1974 to May 1980; Saudi Arabia: crude oil capacity, production, and shut-in, monthly, March 1974 to May 1980; OPEC (Ex-Iran and Saudi Arabia): capacity, production and shut-in, monthly, June 1974 to April 1980; non-OPEC Free World and US production of crude oil, monthly, January 1973 to March 1980; oil stocks: Free World, US, Japan, and Europe (landed), 1973 to first quarter 1980; petroleum consumption by industrial countries, monthly, January 1973 to December 1979; USSR crude oil production, monthly, January 1974 to May 1980; Free World and US nuclear generation capacity, monthly, January 1973 to April 1980; world crude oil production by area, annually, 1947 to 1979; estimated proved world reserves of crude oil, annually, January 1, 1948 to 1980; world marketed production of natural gas, annually, 1950 to 1979; estimated proved world reserves of natural gas, annually, January 1, 1967 to 1980; US trade in natural gas, 1955 to 1979; US imports of crude oil and products, monthly, January 1973 to May 1980; landed cast of Saudi crude oil in current and 1974 dollars, monthly, April 1974 to March 1980; US trade in coal, monthly, January 1973 to April 1980; summary of US merchandise trade, 1976 to April 1980 and Energy/GNP ratio, annually, 1947 to 1949 and, quarterly, first 1973 to first 1980.

29165 **1979 Missouri Energy Profiles.** Jefferson City, MO; Missouri Dept. of Natural Resources (1979). 241p. (NP—24428).

In this fourth volume of Profiles the attempt is made to maintain consistency so that users may continue to refer to the Profiles Book without disruption. Attempts have been made to update all tables to 1978 if possible. However, on some occasions the last date for which data were available was for 1976. Profiles is prepared by the Department of Natural Resources - Missouri Divison of Energy, which is also responsible for managing the state parks, air and water environmental quality, solid-waste disposal, soil and water conservation, historical preservation, and geology and land survey. In 1978, it was determined that the thrust of the state's energy program should be to: promote the development of alternate sources of energy; plan for and be ready to respond to energy supply and/or distribution problems; and encourage energy conservation. To further all of these purposes, an Energy Information Clearinghouse was created to provide information on all aspects of these major areas of state activity. This Profiles series is intended to be a reference source for government decision makers and the energy producers and consumers of this state regarding the sources and uses of energy in Missouri.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 28917, 28918, 28919, 29191, 29203, 29204, 29219, 29220, 29223, 29233, 29248, 29267, 29270, 29434

29166 (BNL—51056) **Brookhaven integrated energy/economy modeling system and its use in conservation policy analysis.** Groncki, P.J.; Marcuse, W. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Jul 1979. Contract AC02-76CH00016. 35p. NTIS, PC A03/MF A01.

The approach used at BNL to model the impact of the introduction of advanced energy technologies in response to increased energy prices has been to link econometric, process, and input-output models. The econometric model generates growth, employment, productivity, inflation, final demand, and price-determined input-output coefficients for a ten-sector interindustry model. The outputs from the six energy sectors are used to drive a national energy process model which supplies energy prices, fuel mix, and energy capital requirements to the econometric model. The four nonenergy final demands from the econometric model are disaggregated and used with the energy demands from the process model to drive a 110-sector input-output model. The nonenergy coefficients in the input-output model are fixed, but the energy coefficients are variable - reflecting the technologies chosen by the solution of the process model. Coefficients representing advanced-energy-technology production functions have been incorporated in the input-output structure. This approach is briefly described, and three applications of this set of linked models are presented: (1) reports the findings of a study of the effects of various levels of conservation on the rate of growth in GNP and other economic indicators; (2) describes an application of the linked models to an accelerated solar-technology scenario, focusing on the long-run macroeconomic impacts of increased solar utilization; and (3) currently in progress, examines the robustness of two policies (a supply and a demand policy) and their effect on the penetration of renewable technologies across a range of reference cases designed to capture several of the uncertainties faced by decision makers. 63 references.

29167 (BNL—51165) **National Center for Analysis of Energy Systems: program summaries for 1979.** (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1979. Contract AC02-76CH00016. 70p. NTIS, PC A04/MF A01.

This Center, founded in January 1976, is one of four areas comprising the Department of Energy and Environment at Brookhaven National Laboratory. The major ongoing activities of the Center concern integrated, quantitative analyses of technological, economic, and environmental aspects of energy at the regional, national, and international levels. The objectives, activities, and sources of support of each of the programs are described and the major accomplishments during the year are outlined. Some of the planned future activities of the Center are indicated, and recent publications are listed.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 28377, 28379, 28867, 29167, 29189, 29193, 29198, 29202, 29233, 29235, 29253, 29255, 29635

29168 (DOE/EIA/AR—0220) **Comparison of energy expenditures by elderly and non-elderly households: 1975 and 1985.** Siler, A. (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1980. 53p. NTIS, PC A04/MF A01.

The relative position of the elderly in the population is examined and their characteristic use of energy in relation to the total population and their non-elderly counterparts is observed. The 1985 projections are based on demographic, economic, and socioeconomic, and energy data assumptions contained in the 1978 Annual Report to Congress. The model used for estimating household energy expenditure is MATH/CHRDS - Micro-Analysis of Transfers to Households/Comprehensive Human Resources Data System. Characteristics used include households disposable income, poverty status, location by DOE region and Standard Metropolitan Statistical Area (SMSA), and race and sex of the household head as well as age. Energy use by fuel type will be identified for total home fuels, including electricity, natural gas, bottled gas and fuel oil, and for all fuels, where gasoline use is also included. Throughout the analysis, both income and expenditure-dollar amounts for 1975 and 1985 are expressed in constant 1978 dollars. Two appendices contain statistical information.

29169 (LBL—10803) **DCN/SEEDIS. Annual report, FY 1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01.

The Distributed Computer Network (DCN) is designed to provide a nationwide homogeneous minicomputer network to support planning and analysis activities for the Department of Labor (DOL) regional and national offices. DCN provides a distributed environment which provides shared access to DOL data bases and sophisticated data retrieval, analysis, and display capabilities. The national office and each regional office will be provided with the

capability to manage its own data bases, make appropriate data bases available to all offices on the network, and access data bases on the network. Activities concerning the following are summarized for DCN: hardware systems; mass-storage systems; software acquisition; LBL-supplied software; data base management systems; networking and communications; and training and technical support. The section on SEEDIS includes: transfer of SEEDIS to the DCN; future directions for SEEDIS; and archiving the SEEDIS data bases. The Labor Market Projections Model and the ESARS Data Project are also summarized briefly.

29170 (UCID—18611) **Energy and productivity: implications for real income and inflation.** Cooper, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 May 1980. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01.

Falling productivity growth over recent years has become one of the nation's foremost economic problems. This paper examines some possible causes, and concludes that, since 1973, rising energy prices have been responsible for most of the productivity growth decline. The paper also assesses the negative impact of past energy-price increases on the rate of inflation in the US. It concludes with discussions of the outlook for future productivity and energy prices and suggests appropriate policy responses such as incentive schemes and relaxation of regulatory practices.

29171 **Industrial development in the TVA area during 1979.** Knoxville, TN; Tennessee Valley Authority (1980). 38p.

Industrial development in the Tennessee Valley Region during 1979 included 181 new industrial plants and 281 plant expansions, which combined to increase power demand, 470,000 kilowatts, accounted for over $2 billion investment, and added 28,000 new employment opportunities. Details of these totals are presented by major industry group and location. Industrial development trends during the 1970s show that power demand and employment peaked in 1973, while investments rose sharply in 1979. (DCK)

29172 **Advances in the economics of energy and resources. Volume 2. The production and pricing of energy resources.** Pindyck, R.S. (ed.). Greenwich, CT; JAI Press Inc. (1979). 262p.

A research annual.

This volume, Vol. 2, of an economic analysis of energy and resources focuses on the production, pricing, and management functions. The topics covered by the ten contributors cover a wide range of problems, including the statistical forecasting of resource discovery rates, the optimal exploitation and pricing of resources, the role of supply in world resource markets, and the relationship between resource markets and the macro-economy. 40 figures, 26 tables, 135 references.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 29191, 29194, 29203, 29266

29173 (DOE/EV—0084) **Environmental-control-technology activities of the Department of Energy in FY 1979.** (Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology). Jun 1980. 52p. NTIS, PC A04/MF A01.

This report provides an annual identification and summarization of environmental control RD and D activities and associated funding conducted by DOE in conjunction with developing environmentally acceptable energy technologies. Environmental control technology is an integral part of the DOE energy technology R, D, and D effort. As the third in a series of annual reports on environmental control R, D, and D activities within DOE, this report may serve as a basis for evaluating program trends. The report presents background material that contributes to the capability to evaluate and assess the environmental control accomplishments, issues, gaps, and overlaps associated with energy development within DOE, in conjunction with other agencies, and in the private sector. A measure of the change in emphasis in the environmental control technology activities within DOE is also presented, indicating shifts, if any, in funding levels for each of the energy technologies. Total DOE FY 1979 budget outlay allocated to environmental control activities was $421,533,000, or 5.0% of the total FY 1979 DOE budget. This report summarizes the inputs received from the energy technology areas. These inputs were submitted in accordance with a description of environmental control related activities, which are those activities directed at research, development, and demonstration of processes, procedures, systems, subsystems, and strategies that directly or indirectly eliminate, minimize, or mitigate environmental impacts. 25 references, 10 figures, 40 tables.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 29165, 29172, 29180

29174 (UCRL—84322) **Use of all forms of energy.** Stephens, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 9p. (CONF-800716—10). NTIS, PC A02/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

With conservation, conversion of oil and gas burning boilers to coal, full use of nuclear, more fuel efficient automobiles, and creation of a synthetic fuels industry based on coal and oil shale, short term energy crisis can be resolved. Short term R and D on more efficient synthetic fuels processes, electric vehicles, and solar will carry us past 200. Over the long run, coal, the breeder reactor, solar and possibly fusion and geothermal will replenish our energy needs as the world supplies of oil and gas decline. The money, manpower, knowhow, the coal, the uranium, and the oil shale are available. We need political courage. The energy will not be cheap, and environmental risks are involved. But the risks of not producing the energy are even more severe. We can and must do it.

29175 **Ocean energy: forms and prospects.** Isaacs, J.D.; Schmitt, W.R. (Scripps Institution of Oceanography, La Jolla, CA). *Science;* 207: No. 4428, 265-273(18 Jan 1980).

The nature and distribution of power sources of the sea other than petroleum are discussed. These include waves, tides, currents, salinity and temperature gradients, submarine geothermal sources, salt domes, ice, and other marine-associated concentrations. Opportunities to employ these marine power resources directly rather than for contributions to power grids or power-intensive products are considered.

29176 **New Mexico's energy resources '79: annual report of Bureau of Geology in the Mining and Minerals Division of New Mexico Energy and Minerals Department.** Arnold, E.C.; Hill, J.M. (comps.). Socorro, NM; New Mexico Bureau of Mines and Mineral Resources (1980). 55p. $3.00.

Production of crude oil in New Mexico continued to decline with a production level of 78.7 million barrels in 1978, or five percent less than the previous year. Condensate production increased slightly, but total crude oil was down because production rates of the state's largest producing pool, the Empire Abo Pool, was down. Natural gas production also decreased from the previous year, although drilling set an eight-year record. Production projections have been revised to show differing decline rates through 2000. Crude oil reserves for 40 pools were calculated along with reserves for five gas pools. The state experienced a 7.5 percent coal-production increase, with 12.8 million tons extracted in 1978 and a 31 percent increase projected for 1979. Coal reserves are reported by depth of bed. Uranium oxide production was 9400 tons, a 24 percent increase. New Mexico has over 50 percent of all forward-cost categories of uranium reserves. The US Bureau of Land Management has issued 118 leases for geothermal energy applications in 46 designated low-temperature areas. 69 references, 14 figures, 45 tables.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 29173, 29200

29177 (BMFT-FB-T—79-186) **Documentation of and information on protective rights to government support on Technological Research and Development. Final report.** Gretscher, I. (VDI-Technologiezentrum, Berlin (Germany, F.R.)). Dec 1979. 242p. (In German). NTIS (US Sales Only), PC A11/MF A01.

The German Ministry of Research and Technology (BMFT) supports research and development projects relating to industrial and institutional areas. The supported programs relating to Technological Research and Development include the categories electronics, metallurgical process techniques and material technology, nonnuclear energy techniques, physical technologies, and technical communication. The present compilation contains those protective rights that resulted from government-supported programs within these categories. It contains mainly applications filed in 1976 and 1977. The protective rights are described together with complete data, characterizing keywords, and brief descriptive abstracts in order to allow documentation and information. The contents of these protective rights can be obtained by use of the classification according to the given categories, the classification according to the international Patent Classification, and an index.

29178 (NP—24436) **Energy research and resource development in Kansas, FY 79.** (Kansas Energy Office, Topeka (USA)). Feb 1980. 44p. NTIS, PC A03/MF A01.

In FY 79 about 2 million dollars was spent on energy research and resource development; of the total, 51% was Federally funded,

39% was state funded, and the rest was funded through other resources. Most of the research was done at three institutions: Kansas State University, University of Kansas, and the Kansas Geological Survey. These institutions represent 92% of the total energy research funds. Nonrenewable energy research accounted for 56% of all funds. Renewable accounted for 12% and conservation accounted for 27%. The remaining 5% was for a project to forecast energy demand and supply, which was more or less in its own category. Eighty-two percent of state funds were dedicated to nonrenewable research, with the rest split between renewable and conservation. In contrast, Federal monies showed more balance. Nonrenewable research accounted for 40%, renewable 12%, conservation 38% and unclassified the remaining 10%. Private-sector funds (foundations, not-for-profit agencies, corporations, etc.) were distributed along similar proportions as Federal funds. In sum, energy research and resource development in Kansas in fiscal year 1979 was modest. While the nonrenewable energy resources were well represented, efforts were very limited in solar, wind, and biomass alternate energy strategies. Conservation research, while faring better than renewable research, was nonetheless also small.

29179 (SAND—79-1483) **Realistic approach to the planning of high-technology, high-risk projects.** Becktell, M.J. (Sandia Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01.

The need for changes in philosophy and for a practical and realistic approach to the management plan used to support high-technology, high-risk projects, calls for bold, honest planning, and unbiased, objective guidance.

29180 West Virginia University Energy Research Center: annual report, 1979. Morgantown, WV; WVU Energy Research Center (1979). 67p.

The major accomplishments during 1978-79 included: (1) the Energy Research Center's designation as one of only 22 Mining and Mineral Resources Research Institutes; (2) its selection for development and operation of the National Small Wastewate Flows Clearinghouse by the Environmental Protection Agency; (3) the establishment of a University-wide energy research organization featuring extensive faculty involvement in program evaluation and planning and resource allocation; and (4) the development of an overall research plan to focus university coal and energy research resources on nine areas of major importance to the citizens of West Virginia. Details of these accomplishments and summaries of 176 active research projects are reported.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 28981, 28999, 29003, 29092, 29174, 29175, 29176, 29189

29181 International standardization of quality assurance. French, F.J. (Central Electricity Generating Board, London (UK)). *Nucl. Energy;* **19**: No. 1, 39-40(Feb 1980).

The FORATOM Working Group on Quality Assurance, formed in 1976 has been comparing National Codes and Standards, first by considering definitions, following with a detailed evaluation of Regulatory Requirements, and concluding with an assessment of Quality Assurance Programme Standards used for procurement. Details of its considerations are given and the following recommendations are made: that IAEA or ISO should be asked to prepare a set of internationally acceptable definitions for their member countries to adopt; that IAEA should restructure its Code of Practice into 18 criteria for all FORATOM countries to adopt; and that the ISO draft Standard on Quality Assurance for Nuclear Power Plants be adopted by all member countries as soon as it is issued in final form.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 29160

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 28628, 29021, 29210, 29213, 29258, 29269

29182 Cogeneration: what's ahead. Streb, A.J. pp 100-109 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

Cogeneration can be employed to complement industrial processes, capturing thermodynamic availability which would otherwise be lost in the normal operation of that process. Topping cycle cogeneration systems are coupled with low temperature industrial processes, bottoming cycle cogeneration systems as coupled with high temperature industrial processes. To maximize the energy saving opportunities, conversion systems must be available which are capable of efficient operation over a broad temperature range, with maximum fuel flexibility. Estimates of the magnitude of the conservation opportunity is provided, the technology needs are surveyed, and the overall cogeneration program within DOE is described.

CONSERVATION

REFER ALSO TO CITATION(S) 29166, 29206, 29219, 29226, 29227, 29228, 29229, 29230, 29234, 29237, 29239, 29242, 29243, 29244, 29245, 29247, 29249, 29252, 29264, 29265, 29266, 29267, 29270

29183 (DOE/CS—0160) **Annual report to the President and the Congress on the State Energy Conservation Program for calendar year 1979.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Apr 1980. 81p. NTIS, PC A05/MF A01.

Included in this report are discussions regarding estimates of the energy conservation achieved, the degree of State participation and achievement, descriptions of innovative energy-conservation programs undertaken by States, and findings from an independent evaluation of the State Energy Conservation Program. One of those findings, suggesting that the program's legislative goal of a 5% reduction in 1980 consumption might not be met, is specifically pointed out and discussed in detail. Also included is a discussion of the Energy Management and Partnership Act (EMPA) as proposed in May 1979. While there have been several congressional revisions of EMPA, the only change in the Administration's proposal has been as of the end of 1979 to raise the authorization level to permit further augmentation of the role of local governments.

29184 (LBL—10538) **Energy demand and conservation in Kenya: initial appraisal.** Schipper, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 29p. (CONF-800384—1). NTIS, PC A03/MF A01.

From Electric Power Research Institute workshop on energy and the developing nations; Stanford, CA, USA (19 Mar 1980).

Ongoing research into the use and conservation of energy in Kenya is reported briefly. A partial accounting of energy use in Kenya is presented, and evidence that some energy conservation has been taking place is discussed. A fuller accounting for all commercial energy flows is both possible and desirable. The work presented should serve as a basis for further data collection and analysis in Kenya, and can be used as a model for similar efforts in other countries. The author intends to continue much of this energy accounting in Kenya in the latter half of 1980.

29185 Incentives and motivations of energy management programs. Rohles, F.H. Jr. (Kansas State Univ., Manhattan). pp 8.3-8.12 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

Motivation may be considered to be the key to all behavior. Whether biological, economic, or social, the drive is the stimulus that triggers the motivational sequence. Once this is started, behavior begins that is directed toward the goal or incentive, and when this is attained, the drive subsides. Energy savings constitutes a social drive. Cost savings, resulting from a reduced use of energy, represent an economic drive. Working together, they result in a Total Energy Management Program, TEMP, which will be directed in a large part to effect dollar savings for the company. The TEMP must also develop a communication link with the workers and they, too, will be rewarded for their efforts in the total program - rewards which must have meaning and which must be adequate for the effort expended. And finally, the feedback link from the workers to the TEMP team will complete the communication process. When this process is understood, and then followed conscientiously and honestly, the result will be a total commitment to an effective energy savings program that will work.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 28376, 28396, 28397, 29164, 29165, 29172, 29176, 29186, 29189, 29250

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 28379, 28393, 28457, 28582, 29165, 29177, 29206, 29238

29186 (DOE/RG—0037) **Draft regulatory analysis: notice of proposed rulemaking motor gasoline allocation revisions.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Jun 1980. 92p. NTIS, PC A05/MF A01.

The Draft Regulatory Analysis is prepared for those proposed regulations which either may have a major impact on the general economy, individual industries, or geographic regions and levels of government, or may be significant in that they affect important DOE policy concerns and are the object of public interest. The problems and proposed solutions for the Notice of Proposed Rulemaking and Public Hearings on the Motor Gasoline Allocation Program are examined. The ERA's mandate for this program is set out in the Emergency Petroleum Allocation Act of 1973. Under this Act, the President is empowered to enforce, at his discretion, price and allocation controls on petroleum and petroleum products, including gasoline, through September 30, 1981. The Act sets the following allocation goals: protect public health; maintain public services and agricultural operations; foster competition in the petroleum industry; distribute petroleum among industry sectors and US regions equitably; and minimize economic disruption and unnecessary interference wth market mechanisms.

29187 (GFETC/IC—79/1, pp 232-235) **Energy and North Dakota.** Link, A.A. 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

A brief history is presented concerning use of lignite in North Dakota. In 1909, 103 mines produced 372,000 tons of lignite. By 1978, over 13 million tons were mined. Estimates indicate production in excess of 18 million tons in 1985 without a synthetic fuel industry. Although North Dakota is the most agrarian state, attempts are being made to diversify its economy, and utilization of the lignite resource is one way for diversification. A 12 point energy program has been developed for North Dakota. The program rests on four premises addressing long term goals and expectations - history, economic aspirations, influence of development on environment and way of life, and level of involvement of the State's people. North Dakota strongly supports the construction of the 125 mscfd synthetic natural gas facility near Beulah, North Dakota, to serve as a demonstration plant. In North Dakota, people are aware of the conflict between emotional senses and reason. The goal is to pursue reason.

29188 (SERI/TR—434-424) **National Energy Act statutes and solar energy.** Howard, J. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract EG-77-C-01-4042. 70p. NTIS, PC A04/MF A01.

The National Energy Act of 1978 contains many provisions that will significantly affect solar technology commercialization and solar energy users. Four of the five statutes that comprise the National Energy Act deserve close attention. The National Energy Conservation Policy Act will promote residential solar installations. The Energy Tax Act will accelerate both residential and commercial solar system applications. The Public Utilities Regulatory Policies Act promotes efficient use of utility resources as well as decentralized power production. And, the Power Plan and Industrial Fuel Use Act places severe restrictions on future burning of petroleum and natural gas, which should lead some operators to build or convert to solar energy systems. Each of the preceding acts are considered in separate sections of this report. Federal regulations issued pursuant to the various provisions are also identified and discussed, and some of the problems with the provisions and regulations are noted.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 28376, 28379, 29176, 30027

29189 (DOE/IA—0002T/5(80)) **International energy indicators.** Bauer, E.K. (ed.). (Department of Energy, Washington, DC (USA). Office of Current Reporting). May 1980. 30p. NTIS, PC A03/MF A01.

International statistical tables and graphs are given for the following: (1) Iran - Crude Oil Capacity, Production and Shut-in, June 1974-April 1980; (2) Saudi Arabia - Crude Oil Capacity, Production, and Shut-in, March 1974-Apr 1980; (3) OPEC (Ex-Iran and Saudi Arabia) - Capacity, Production and Shut-in, June 1974-March 1980; (4) Non-OPEC Free World and US Production of Crude Oil, January 1973-February 1980; (5) Oil Stocks - Free World, US, Japan, and Europe (Landed, 1973-1st Quarter, 1980); (6) Petroleum Consumption by Industrial Countries, January 1973-December 1979; (7) USSR Crude Oil Production and Exports, January 1974-April 1980; and (8) Free World and US Nuclear Generation Capacity, January 1973-March 1980. Similar statistical tables and graphs included for the United States include: (1) Imports of Crude Oil and Products, January 1973-April 1980; (2) Landed Cost of Saudi Oil in Current and 1974 Dollars, April 1974-January 1980; (3) US Trade in Coal, January 1973-March 1980; (4) Summary of US Merchandise Trade, 1976-March 1980; and (5) US Energy/GNP Ratio, 1947 to 1979.

29190 **National Energy Plan coal production goals: new responsibilities for the states.** Helme, E.A. Contract EC-77-C-01-8775. Washington, DC; National Governors' Association (1978). 23p. $2.00.

This report enumerates and discusses the new responsibilities that would be imposed upon the states if the coal production goals of the National Energy Plan are achieved. It includes an analysis of the implications for both the producing and consuming states and provides an initial outline of the possible shape of future state energy management from the standpoint of resource development. State governments face many demands because of coal development and coal conversion. If producing states develop the capacities needed to cope effectively with these demands and are given a significant role in Federal decision making, they will be able to exert influence on the pace and direction of coal development. Non-producing states need to focus their attention on the impacts of coal conversion on state energy management responsibilities and on consumers. (DP)

COAL

REFER ALSO TO CITATION(S) 28373, 28377, 28378, 29174

29191 (LASL—80-15) **LACUMS: a national energy-environment model.** Kolstad, C.D. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01.

Los Alamos Scientific Laboratory has developed a computer model to examine the effects of alternative governmental reulations, particularly environmetal regulations, on coal-related industries. The Los Alamos Coal-Use Modeling System (LACUMS) simulates the activities of coal producers and possible coal users in the United States. By imposing many different regulatory and economic conditions on the system, the responses of industry to these conditions can be simulated. Thus, the model can contribute to the design of governmental policy. Because some important factors such as politics are not part of the model structure, the results are only one of many aids for making governmental policy decisions. LACUMS has also been used to determine how water scarcity in the West may effect the Federal program for the accelerated development of synfuels. The many other uses of LACUMS are listed.

29192 **Electric power generation from coal-derived liquid fuels.** Wolk, R.H. (Electric Power Research Inst., Palo Alto, CA). *Public Util. Fortn.;* **105**: No. 9, 21-26(24 Apr 1980).

Over the last few years, the Federal government through various actions has made it clear to the electric utility industry that its use of natural gas and petroleum products should decrease continuously in the future. However, much of the gas- and oil-fired generating equipment that utilities now have in place was purchased at very low prices relative to today's prices for coal and nuclear generating plants and has significant life remaining. One strategy which could result in continued utilization of this equipment is to use coal-derived fuels. It is unlikely, however, that the high prices of liquid fuels made from coal will make them a viable fuel for baseload generation with new equipment. However, for peak-load service, it appears that clean coal-derived liquids are the economic choice with turbines employing existing technology. In the midrange (1000 to 3000 hours per year), new combined-cycle machines fed by these fuels could be the preferred option. A number of large coal-liquefaction demonstrated projects are now being considered by the Federal government. Other processes are at the large pilot plant level of development. Commercial plants can be on stream beginning in about 1987, but only if project commitments are made in the near future.

PETROLEUM

REFER ALSO TO CITATION(S) 28393, 28396, 28397, 29174

29193 (DOE/PE—0019-03) **State of competition in gasoline marketing. Part I. The effects of refiner operations at retail (a study required by Title III of the Petroleum Marketing Practices Act).** Delaney, J.B.; Fenili, R.N. (Department of Energy, Washington, DC (USA). Office of Competition). 1979. 119p. NTIS, PC A06/MF A01.

As part of its overall approach to the Title III Study, the Office of Competition conducted several regional hearings. A list of witnesses and hearing locations is attached. These hearings focused on four major issues: (1) the extent of subsidization, including documentation if possible; (2) the effect of subsidization on competi-

tion; (3) the role of refiner and wholesaler operations at retail and the impact of Department of Energy regulations, and other important institutional factors, on competition; and (4) proposed remedies for insuring the long-term consumer interests as related to motor fuel marketing. The testimony presented at these hearings was intended to supplement the quantitative information obtained from the regional retail outlet surveys and the nationwide refiner survey. Not surprisingly, some of the testimony did not address the central theme of the hearings, but focused on current problems faced by gasoline marketers - e.g., the receipt of state set-aside gasoline allocations or the queuing problem at major terminals. Conversely, other testimony was directed squarely at the issue of subsidization. We have found this testimony to be useful in the preparation of the Title III Study.

NATURAL GAS

REFER ALSO TO CITATION(S) 28400, 29174

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 28411, 28412, 29174

HYDROGEN AND SYNTHETIC FUELS

29194 (DOE/EA—0107) **Environmental assessment: notice of proposed rulemaking for the allocation and pricing of gasohol.** (Department of Energy, Washington, DC (USA). Office of Regulations and Emergency Planning). Jun 1980. 151p. NTIS, PC A08/MF A01.

This report presents the results of an environmental assessment (EA) of a pending proposal by the Economic Regulatory Administration concerning the allocation and pricing of gasohol and the unleaded gasoline which is used as its blend stock, and an alternative proposal to exempt gasohol and unleaded blend stock from allocation and price regulations. The objective of this EA is to identify and assess the seriousness of environmental impacts resulting from the proposed rule in order to determine whether an environmental impact statement is needed. A regulatory analysis has also been prepared on the proposed rule. A summary of the findings of this EA is provided. It is concluded that no significant environmental impacts are attributable to the proposed rule and, therefore, that an environmental impact statement is not required. 29 references, 5 figures, 15 tables.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 29205, 29241

29195 (ANL/CNSV-TM—32) **Assessment of potential and existing problems concerning interface between electric utilities and cogenerators.** (National Economic Research Associates, Inc., Los Angeles, CA (USA)). Mar 1980. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01.

The potential and existing problems concerning the interface between US electric utilities and cogenerators are considered by region. Also considered are regulatory barriers, rates and contracts, economic feasibility, and impact on system planning. Finally, the impact of the National Energy Act on the marketability potential of cogeneration is reviewed. The three appendixes summarize the utility meetings on cogeneration held in Washington, DC, Los Angeles, and Chicago.

29196 (ANL/CNSV-TM—35) **Review of the community energy peak leveling program (CEPLP).** (National Economic Research Associates, Inc., Los Angeles, CA (USA)). Mar 1980. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01.

A review of the Community Energy Peak Leveling Program (CEPLP), as applied in the Los Angeles and Orange County experiments, indicates that the program is a workable method of reducing demands on a utility system at the time of system peak. The program should not be used as a method of reducing energy consumption. Rather, it should be used in utility systems that need additional capacity at the time of their peak demands. Furthermore, the program is most advantageous when applied to a utility system that faces a rather peaked annual load duration curve. The value of the capacity purchased by a utility under CEPLP approaches the marginal cost of capacity to the utility. In most utility systems, this value equates to the cost per kilowatt of a combustion turbine (currently about $3.00/kW/mo). The best form of rate schedule for use under the program is an interruptable rate because of the unwillingness of participants in the program to reduce the level of environmental comfort and other operations below certain minimum levels on a continuing basis. The interruptible rate form allows the program to yield its maximum benefit to the utility with the least amount of disruption of the participant's operations. CEPLP has several advantages for both the utility and the participants in the program. The utility, it represents a method of buying capacity during system peaks. That capacity can be purchased relatively rapidly when compared to the normal lead times required to plan, secure approval of, and build new peaking capacity. For participants in the program, there are significant economic benefits that take the form of a one-time energy saving during the audit phase of the program, a payment (in some form) from the utility involved and, to a lesser degree, a further energy cost-saving through an interruption during the billing period.

29197 (DOE/ERA—0018(79)) **Electric power supply and demand 1979 to 1988 for the contiguous United States as projected by the Regional Electric Reliability Councils in their April 1, 1979 long-range coordinated planning reports to the Department of Energy.** Savage, N.; Graban, W. (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Dec 1979. 80p. NTIS, PC A05/MF A01.

Information concerning bulk electric power supply and demand is summarized and reviewed. Electric-utility power-supply systems are composed of power sources, transmission and distribution facilities, and users of electricity. In the United States there are three such systems of large geographic extent that together cover the entire country. Subjects covered are: energy forecasts, peak demand forecasts, generating-capacity forecasts, purchases and sales of capacity, and transmission. Extensive data are compiled in 17 tables. Information in two appendices includes a general description of the Regional Electric Reliability Councils and US generating capacity as of June 30, 1979. 3 figures, 17 tables.

29198 (DOE/RG—0033) **United States/Mexico electricity exchanges.** (Department of Energy, Washington, DC (USA); Comision Federal de Electricidad, Mexico City). May 1980. 120p. NTIS, PC A06/MF A01.

As a result of the agreement between the respective presidents, a joint study was undertaken to analyze the possibilities of increasing the international electricity exchange between the two countries. Responsibility for this undertaking was assigned to the United States Department of Energy (DOE) and to the Direccion de Energia de Mexico (DEM) through the Comision Federal de Electricidad (CFE). Representatives from Mexico and the US were chosen from the regional utilities along the border between the two countries and made up working groups that particiated in the study. With the support of both governments, and a high degree of cooperation between the two countries, work on the study was completed within fourteen months The completion of the study has been a major step in broadening the base of bilateral energy relations. the study highlights the opportunities for increased electricity exchanges, which could increase cooperation along the common border. Expansion of electricity interchange could offer substantial economic benefit to both countries, both directly and indirectly. Direct benefits include increased reliability of electric power and cost savings through economies of scale and diversity of peak demand patterns. Indirect benefits include improved economic and employment opportunities, especially in the border areas of both countries. This report provides background on the history of past exchanges and the characteristics of the US and Mexico electric systems, a summary of opportunities and incentives, and suggestions for procedures to remove obstacles and constraints.

29199 (DOE/RG/09154—T1) **Consumer's Guide to the economics of electric-utility ratemaking.** (Illinois Office of Consumer Services, Springfield (USA)). May 1980. Contract FG01-79RG09154. 244p. NTIS, PC A11/MF A01.

This guide deals primarily with the economics of electric utilities, although certain legal and organizational aspects of utilities are discussed. Each of the seven chapters addresses a particular facet of public-utility ratemaking. Chapter One contains a discussion of the evolution of the public-utility concept, as well as the legal and economic justification for public utilities. The second chapter sets forth an analytical economic model which provides the basis for the next four chapters. These chapters contain a detailed examination of total operating costs, the rate base, the rate of return, and the rate structure. The final chapter discusses a number of current issues regarding electric utilities, mainly factors related to fuel-adjustment costs, advertising, taxes, construction work in progress, and lifeline rates. Some of the examples used in the Guide are from particular states, such as Illinois and California. These examples are used to illustrate specific points. Consumers in other states can generalize them to their states and not change the meaning or significance of the points. 27 references, 8 tables.

29200 (EPRI-PS—1141-SR) **Overview and strategy: 1980-1984 Research and Development Program Plan.** (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1979. 208p. NTIS, PC A10/MF A01.

This document - addressed to the planners, executives and other decision makers of EPRI's supporting utilities and to those with managerial responsibilities in EPRI - describes the basic thrust

and rationale of the Institute's R and D activities for the period 1980 to 1984. Although this plan is reformulated each year and is gradually modified in response both to changing conditions and to the findings and developments of EPRI's ongoing R and D programs, this document is unique in a number of respects, most notably in its articulation of the general strategy that underlies all of EPRI's research and development work. It is meant to provide a set of dependable, usable guidelines for those within EPRI who must direct and manage many concurrent programs and for those in the utilities who must make decisions about their own future course.

29201 Do time-of-use rates change load curves: and how would you know. Acton, J.P.; Mitchell, B.M. (Rand Corp., Santa Monica, CA). *Public Util. Fortn.;* 105: No. 11, 15-24(22 May 1980).

Utilities and regulators need to know what, if any, effect that time-of-use (TOU) rates will have on electricity loads. The question raises serious methodological challenges because no means of measurement is perfect. The authors explore these difficulties and then apply alternative measures to actual load data drawn from European and United States utility systems. They find wide variability in responsiveness to TOU rates from one industry to another and between utility systems, depending on the method used and the length of time that rates have been in effect. They conclude that TOU rates clearly change load shapes but are uncertain whether United States utilities will ever see the degree of response found in European data. 39 references and footnotes, 9 figures.

29202 Tennessee Valley Authority annual report 1979. Knoxville, TN; Tennessee Valley Authority (1979). 86p. $1.00.

The Tennessee Valley Authority (TVA) 1979 annual report looks forward to the challenge of meeting the region's power needs in a way that will be safe, efficient, and reasonably priced; meeting the region's environmental needs of balancing land use between development and preservation; and meeting the human needs by enabling a better and more equitable life for the poor and the elderly. A new format is used in the report to make TVA projects understandable to the public, which is encouraged to participate in the discussion of issues and in the planning of agency projects. The report is presented under the following topics: Energy, Nuclear Safety, Environment, Agriculture, Land Use, Recreation, and Economic Development.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 29192

29203 (EPRI-EA—1375) **Modeling plant location patterns: applications. Final report.** Eagles, T.W.; Cohon, J.L.; ReVelle, C. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Feb 1980. 171p. NTIS, PC A09/MF A01.

The locations of future energy facilities must be specified in order to assess the environmental impact of those facilities. Since major energy-facility construction is planned within a horizon generally less than 10 years in the future and energy/environment studies often cover periods of 25 years and beyond, a method was needed for predicting probable energy-facility locations beyond 10 years ahead. In response to this need, a computer model was developed which generates probable locations for hypothetical energy facilities. The model (limited currently to nuclear- and coal-fired electric-generating plants) is designed to cover a very large geographical region and locates facilities to the county level. The regional demand for additional baseload generating capacity associated with a postulated demand growth rate over any desired time horizon is specified by the user as input to the model. The user also specifies the part of this capacity which will be nuclear and which will be coal-fired. The model uses linear programming to distribute this specified generating capacity to the most probable locations within the region, based on physical factors. Political factors and matters of judgment also contribute to the location process. The model has been applied to two six-State regions. The mid-Atlantic region, consisting of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia and the District of Columbia, was used for model development and initial application. The Pacific Northwest region, consisting of Washington, Oregon, Idaho, Utah, Montana, and Wyoming, was the site of a second application to prove the generality of the model. In both regions, the year 2000 was chosen as the time horizon, and scenarios were run which embodied capacity growth rates of 3 to 7% over the time period 1978-2000.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 29164, 29168, 29184, 29236, 29257

29204 (EUR—6760-EN) **Decomposition of multi-regional energy-flow-optimization models. Final report.** (Louvain Univ. (Belgium)). 1979. 101p. NTIS, PC A06/MF A01.

A major component of the energy models elaborated under the auspices of the EEC authorities is an energy flow optimization model (EFOM). This optimization model turns out to be a large-scale linear-programming (LP) problem. A rather complex software package is being developed to generate and maintain the model data base, to generate the LP problem data and to exploit the results of the optimization. In particular it was decided to investigate procedures that would ease the numerical treatment of the large-scale LP problems arising in energy models. Section II of the present work is devoted to the theoretical aspects of the decomposition principle and of the decomposition algorithm. Sections III and IV deal, respectively, with implementation aspects and refinements of the decomposition algorithm; neither topic is extensively covered in the literature. Computational experience with an experimental FORTRAN code is reported in section V. Section VI proposed a dual-decomposition approach for a class of multi-regional production/distribution optimization systems as exemplified by the EEC multinational energy-flow-optimization model. Finally, in section VII, conclusions are drawn of this work and current and future work with an implementation of the decomposition algorithm are discussed, based on a modular commercial LP code.

29205 Idaho energy facts. Finn, M.W. Boise, ID; Idaho Office of Energy Statehouse (1980). 206p.

Idaho reports a three percent increase in oil and electricity demand and a seven percent decline in natural gas and coal demand for 1978. Consumption statistics and trends are reported for each end use sector and each energy source. Petroleum, natural gas, petroleum and natural gas reserves, coal, and electricity data are presented to show both supply and demand trends. The implications of changing consumption patterns for state energy planning are discussed. Idaho imports 75 percent of its energy and claims only hydroelectric power as a significant indigenous energy source. 32 figures, 101 tables. (DCK)

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 28653, 29166, 29175

29206 (DOE/TIC—10234) **Montana Renewable Energy Viability Project: design report.** (Montana Dept. of Natural Resources and Conservation, Helena (USA)). Sep 1979. Contract FG01-78CS69046. 109p. NTIS, PC A06/MF A01.

In the Montana Renewable Eergy Viability (REV) Project, the potential of energy sources and energy conservation will be examined for use throughout the state of Montana. Building on the substantial commitment of national, state, and private research dollars toward renewable forms of energy, the project will: assemble pertinent technical information relevant to Montana; assess the technical opportunities in terms of social, economic, and environmental effects; and identify and examine particular state and local actions that might influence the rate and type of sustainable energy development. The REV Project is designed to facilitate the implementation of existing state energy policies and builds upon existing research and planning experiences. It will both draw upon and contribute to state energy programs in the areas of energy conservation, renewable energy sources, and general energy planning. Its task is to develop information in a framework which will permit conventional and renewable alternatives to be compared, using the same criteria. The project will focus on the intermediate future, from the present to five to twenty years ahead.

29207 (SERI/RR—744-448) **Decentralized energy studies: bibliography.** Ohi, J.M.; Unseld, C.T.; Levine, A.; Silversmith, J.A. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 58p. NTIS, PC A04/MF A01.

This bibliography is a compilation of literature on decentralized energy systems. It is arranged according to topical (e.g., lifestyle and values, institutions, and economics) and geographical scale to facilitate quick reference to specific areas of interest. Also included are articles by and about Amory B. Lovins who has played a pivotal role in making energy decentralization an important topic of national debate. Periodicals, other bibliographies, and directories are also listed.

29208 (SERI/TR—744-514) **Matching renewable energy systems to village-level energy needs.** Ashworth, J.H.; Neuendorffer, J.W. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-77CH00178. 65p. NTIS, PC A04/MF A01.

This report provides a five step process for matching alternative renewable energy technologies with energy needs in rural villages of developing countries. Analytic tools are given for each of the five steps as well as information that can be expected. Twelve characterization criteria are developed to assist in the matching process. Three of these criteria, called discrimination criteria, are

used for preliminary screening of technology possibilities for each need. The other criteria address site-specific temporal, climatic, social, cultural, and environmental characteristics of the energy need, technology, and cost considerations. To illustrate the matching process, seven basic human needs for energy are matched with seven potential renewable energy technologies. The final portion of the paper discusses the advantages of such a matching process and the resources required to initiate such an effort within a development project. Specific recommendations are given for field-testing this process and actions that could be taken immediately in basic research and development, applied research and technology modification, demonstrations, and commercialization to assist in the future diffusion of renewable energy technologies to rural areas of developing countries.

SOLAR

REFER ALSO TO CITATION(S) 28584, 28587, 28588, 28625, 28651, 28749

29209 (SERI/TR—352-504) **Potential displacement of petroleum imports by solar energy technologies.** DeLeon, P.; Jackson, B.L.; McNown, R.F.; Mahrenholz, G.J. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 69p. NTIS, PC A04/MF A01.

The United States currently imports close to half of its petroleum requirements. This report delineates the economic, social, and political costs of such a foreign oil dependency. These costs are often intangible, but combined they clearly constitute a greater price for imported petroleum than the strictly economic cost. If we can assume that imported oil imposes significant socioeconomic costs upon the American economy and society, one way to reduce these costs is to develop alternative, domestic energy sources - such as solar energy technologies - which can displace foreign petroleum. The second half of this report estimates that by the year 2000, solar energy technologies can displace 3.6 quads of petroleum. This figure includes solar energy applications in utilities, industrial and agricultural process heat, and transportation. The estimate can be treated as a lower bound; if the United States were to achieve the proposed goal of 20 quads by 2000, the amount of displaced oil probably would be greater. Although all the displaced oil would not be imported, the reduction in imported petroleum would relieve many of the conditions that increase the present cost of foreign oil to the American consumer.

GEOTHERMAL

REFER ALSO TO CITATION(S) 28840, 28865, 28866, 28868, 28893, 29176

OTHER

REFER ALSO TO CITATION(S) 28553, 28576, 28898

29210 **Energy from waste: a program for Ontario.** Toronto, Ontario; Ministry of Energy (1980). 27p.

Ontario is exploring the energy potential of using waste products to produce steam and electricity in the near future and synthetic liquid fuels in the more distant future. The policy objective is to increase the Province's contribution to energy self-sufficiency. The types of wastes available for this purpose and the technologies under development are reviewed. The economics of commercial waste processing are examined and agricultural waste, forest residues, biomass energy plantations, and synthetic liquid fuels from biomass are judged to be nearing feasibility. Cooperative financing and non-capital arrangements between private companies and the government can take several forms. 13 figures. (DCK)

ENERGY CONVERSION

MHD GENERATORS

REFER ALSO TO CITATION(S) 28363

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 29575

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 28921

29211 (DOE/FE/2614—3) **Engineering test facility conceptual design. Final technical report.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Feb 1980. Contract EF-77-C-01-2614. 159p. NTIS, PC A08/MF A01.

Because of the close relationship between the ETF design work conducted under this contract, and the design work of Potential Early Commercial MHD Power Plants (PSPEC) conducted under a separate and parallel DOE/NASA study contract, (DEN 3-51), the ETF design work reported on here was coordinated as far as possible with the design information developed in the above-mentioned separate PSPEC study. The reference power system configuration originally specified for the ETF considered the use of a high-temperature-air preheater, separately fired initially with oil and subsequently with a LBtu gas produced in a coal gasifier integrated with the power plant. The potential attractiveness of using oxygen enrichment in combustion of the coal for early commercial MHD power plant applications was indicated in our original ETF Conceptual Design Document. This eliminates the need for a high-temperature-air preheater and its associated gasifier. The results from our initial parametric design analysis in the separate study of Early Commercial MHD Power Plants reinforced the potential attractiveness of the use of oxygen enrichment of the combustion air. Therefore, preliminary analysis of the use of oxygen enrichment for the ETF was included as part of the ETF contract amendment work reported on here.

THERMOELECTRIC GENERATORS

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 29351

29212 **Thermoelectric generator electrode.** Cole, T. (to Ford Motor Co.). US Patent 4,175,164. 20 Nov 1979. Filed date 10 Apr 1978. 8p.

A new class of porous electrodes deposited on solid electrolyte are described for use in thermoelectric generator devices such as the sodium heat engine. The electrode configuration has an openness that provides especially high electrode efficiency.

FUEL CELLS

DESIGN AND DEVELOPMENT

29213 (ORNL/CON—38) **Development of an energy consumption and cost data base for fuel cell total energy systems and conventional building energy systems.** Pine, G.D.; Christian, J.E.; Mixon, W.R.; Jackson, W.L. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 84p. NTIS, PC A05/MF A01.

This report describes the procedures and data sources used to develop an energy-consumption and system-cost data base for use in predicting the market penetration of phosphoric acid fuel cell total-energy systems in the nonindustrial building market. A computer program was used to simulate the hourly energy requirements of six types of buildings - office buildings, retail stores, hotels and motels, schools, hospitals, and multifamily residences. The simulations were done by using hourly weather tapes for one city in each of the ten Department of Energy administrative regions. Two types of building construction were considered, one for existing buildings and one for new buildings. A fuel cell system combined with electrically driven heat pumps and one combined with a gas boiler and an electrically driven chiller were compared with similar conventional systems. The methods of system simulation, component sizing, and system cost estimation are described for each system. The systems were simulated for a single building size for each building type. Methods were developed to extrapolate the system cost and performance data to other building sizes.

29214 **Apparatus for the direct conversion of solar energy into electricity and a combustible gas by galvanic means.** Fitterer, G.R. US Patent 4,170,534. 9 Oct 1979. Filed date 23 Jun 1977. 8p.

A solid electrolyte galvanic energy conversion cell is described that is capable of being heated to at least 2000°C. It contains a form of carbon as a fuel internally and is exposed externally to a source of oxygen, such as air, to cause the passage of oxygen ions through the electrolyte, thus causing the formation of CO or CO_2 as desired. The carbon, for example, a rod, is in electrical contact with a solid electrolyte material having an oxygen ion permeability at a temperature of at least 705°C. In one embodiment, an end of the cell is heated at the focal point of a parabolic solar energy collector and generates electrical energy while expelling CO gas which may later be oxidized to CO_2 either by combustion or by means of a secondary galvanic cell to generate additional electrical energy. Since such cells are small, a plurality of cells may be arranged to be heated by a single solar collector with the electrical circuits being arranged in

parallel and series configurations to provide the desired power output.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 28582, 29183, 29184

29215 Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979). 245p. (CONF-7810118—). Van Nostrand Reinhold Co., New York, NY.

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

Separate abstracts are included for papers concerning energy conservation in industrial plants; new products and their applications; energy conservation in buildings; potential for waste heat recovery; advances in solar; biomass applications today; wind energy applications; energy management; and energy and the environment.

BUILDINGS

REFER ALSO TO CITATION(S) 28742, 28744, 28797, 28822, 29266, 29267, 29360

29216 Long-term ice storage for cooling applications. Schertz, W.W. US Patent Application 037,078. [nd]. 11p.

A device is described for cooling a stored material and then for later use of the cold thus stored. The device includes a tank containing a liquid such as water which is frozen by means of a reflux condenser heat pipe.

29217 Free piston inertia compressor. Richards, W.D.C.; Bilodeau, D.; Marusak, T.; Dutram, L. Jr.; Brady, J. US Patent Application 037,079. [nd]. 11p.

A free piston inertia compressor comprises a piston assembly including a connecting rod having pistons on both ends, the cylinder being split into two substantially identical portions by a seal through which the connecting rod passes. Vents in the cylinder wall are provided near the seal to permit gas to escape the cylinder until the piston covers the vent whereupon the remaining gas in the cylinder functions as a gas spring and cushions the piston against impact on the seal. The connecting rod has a central portion of relatively small diameter providing free play of the connecting rod through the seal and end portions of relatively large diameter providing a limited tolerance between the connecting rod and the seal. Finally, the seal comprises a seal ring assembly consisting of a dampener plate, a free floating seal at the center of the dampener plate and a seal retainer plate in one face of the dampener plate.

29218 (CONF-800340—, pp 10.21) **Variable capacity compressor controller.** Peltzman, E.S. (Rho Sigma, Inc., North Hollywood, CA). 1980.

From DOE active solar heating and cooling contractors' review meeting; Lake Tahoe, NV, USA (26 Mar 1980).

The objective is to improve heat pump co-efficient of performance, COP, by matching its compressor speed to the heat pump load. Progress is outlined.

29219 (CONS—4214-T1(App.2)) **The Woodlands Metro Center energy study. Case studies of project planning and design for energy conservation.** (The Woodlands Development Corp., TX (USA)). Mar 1980. Contract EM-78-C-01-4214. 286p. NTIS, PC A13/MF A01.

Appendix II of The Woodlands Metro Center Energy Study near Houston consists of the following: Metro Center Program, Conventional Plan Building Prototypes and Detail Parcel Analysis, Energy Plan Building Prototypes, and Energy Plan Detail Parcel Analysis.

29220 (LBL—10900) **Convective heat transfer in building energy analysis.** Gadgil, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 111p. NTIS, PC A06/MF A01.

Thesis.

In the ongoing efforts to study energy consumption in buildings through computer simulations, practically no attention has been given to modeling natural convective heat transfer in buildings. The main reason for this neglect is due to the difficulty of solving the problem numerically. This paper makes a contribution towards the solution of this difficulty by presenting a numerical code for modeling natural convection in rectangular enclosures at Rayleigh numbers up to 10^{10}. Chapter 2 develops the general equations of motion to be solved. Chapter 3 is devoted to simplification of these equations and description of the numerical scheme. Chapter 4 describes the comparisons of the predictions of the computer program based on the numerical scheme with various published experimental and numerical results of other investigators. Chapter 5 illustrates an application of the computer program to investigate the soundness of an assumption commonly made by all the building energy analysis programs.

29221 (ORNL/CON—46) **Appraisal of the M factor and the role of building thermal mass in energy conservation.** Childs, K.W. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01.

A new concept in heat transfer calculations known as the M factor has been introduced to account for thermal storage due to mass in building walls. This report reviews the assumptions behind the development of the M factor. The effect of mass in walls on seasonal or annual energy transmission through walls is examined, as well as the applicability of the M factor as a correction to account for any mass effects. In connection with the effect of mass on seasonal energy consumption, the use of a M factor correction when checking a building for compliance with energy conservation standards such as ASHRAE Standard 90-75 is investigated. The suitability of applying the M factor correction to the peak load determined by a steady-state calculation for equipment sizing is also explored. In addition, the relationship of thermal mass to other parameters that determine loads and energy consumption is investigated, and the role of thermal mass in energy conservation is discussed.

29222 (PNL—3416) **Evaluation of water source heat pumps for the Juneau, Alaska Area.** Jacobsen, J.J.; King, J.C.; Eisenhauer, J.L.; Gibson, C.I. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 151p. NTIS, PC A08/MF A01.

The purposes of this project were to evaluate the technical and economic feasibility of water source heat pumps (WSHP) for use in Juneau, Alaska and to identify potential demonstration projects to verify their feasibility. Information is included on the design, cost, and availability of heat pumps, possible use of seawater as a heat source, heating costs with WSHP and conventional space heating systems, and life cycle costs for WSHP-based heating systems. The results showed that WSHP's are technically viable in the Juneau area, proper installation and maintenance is imperative to prevent equipment failures, use of WSHP would save fuel oil but increase electric power consumption. Life cycle costs for WSHP's are about 8% above that for electric resistance heating systems, and a field demonstration program to verify these results should be conducted. (LCL)

29223 (SAN—1470-T2(App.D)) **Development of a risk analysis model. Appendix D. Gas-fired heat pump case study, Final report, October 1979.** (Dynatrend, Inc., Arlington, VA (USA)). Oct 1979. Contract EC-77-C-03-1470. 146p. NTIS, PC A07/MF A01.

Confronted by major uncertainties in energy supply, demand, and cost, technology suppliers must attempt to make rational manufacturing decisions regarding new energy technologies, technology end-users must attempt to make rational purchasing decisions regarding them, and the DOE Office of Buildings and Community Systems (BCS) must attempt to make rational decisions regarding the type and amount of support it will provide for the development and commercialization of the technologies. One new product development which contains the potential for significant energy savings on a nationwide basis is the gas-fired heat pump. Factors affecting the gas-fired heat pump commercialization decision and the likely results of any action that can be taken to foster that commercialization process are presented. An analysis of the uncertainty associated with basic parameters required for evaluating a venture from the perspective of a manufacturer, such as price, market share, number of units sold, cost of sales, etc. is given. The output from the analysis provides the decision maker with a quantified probabilistic description of the financial outcome (risk vs. return) of the venture in terms of profit, cash flow, net present value, return on investment, etc.

29224 Passive energy applications for the built environment. Ramsey, G.H. pp 220-241 of Energy engineering technology. Atlanta, GA; Fairmont Press, Inc. (1979).

From World energy engineers congress; Atlanta, GA, USA (31 Oct 1978).

The benefits of passive energy systems are listed. A definition is given for passive solar systems. The following topics are included: energy source-stream analysis, complex issues, helplessness, international competition, transferring costs by centralization, energy crises, absurb energy consumption, causes of energy failure, preventative architecture, and preventative urbanism. The emphasis is on changing lifestyles for energy savings. (MHR)

29225 Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978). 354p. (ISU-ERI-AMES—79058; CONF-7810243—).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

A separate abstract was prepared for each of the 16 papers presented at the conference on building energy management. Fourteen papers were included in the Energy Abstracts for Policy Analysis data base.

29226 Keynote address: why energy management. Coad, W.J. (Charles J.R. McClure and Associates, Inc., St. Louis, MO). pp 1.3-1.16 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The energy situation is believed to be unique in that it has never existed before in the history of mankind. The situation can be ignored and business can continue as usual or adjustments can be made in society and our way of life. It is believed that there is no choice but the latter, presenting the most challenging and awesome charge ever to befall a modern society. Dr. M. King Hubbert predicted in 1956 that the petroleum industry was a declining industry. That correct revelation is examined along with shocking action by the Arabs in 1973. In the 1960s an attempt was made to market energy conservation technology, but that failed. The reasons are discussed and some data on the GNP per capita are discussed. The first step in building energy management is to reduce the load energy to the lowest possible value. This is achieved effectively by addressing the fundamental technology of what affects the load. Some techniques of accomplishing reductions in load energy are improved thermal characteristics of opaque building materials, more judicious use of fenestrations, less exterior surface to accomplish the space tasks, and reducing ventilation to a minimal value for health and comfort.

29227 Impact of codes and standards on energy management. Olivieri, J.B. (Lawrence Inst. of Tech., Southfield, MI). pp 1.17-1.30 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

Development of the ASHRAE standards is discussed. It was recognized that ASHRAE 90-75 was a design standard and it would save 50% of energy if the building is operated properly and if equipment is well maintained. Eleven sections made up the standard: Purpose; Scope; Definitions; Exterior Envelope; HVAC Systems; HVAC Equipment; Service Water Heating; Electrical Distribution Systems; Lighting Power Budget Determination Procedure; Energy Requirements for Building Designs Based on System Analysis; and Requirements for Buildings Utilizing Solar, Wind, or Non-depleting Energy Sources. Section 12 has not been accepted yet. All segments of the standard for new building (ASHRAE 90-75) are discussed. For existing buildings ASHRAE prepared the standard 100 P series. These are out for review, but tentatively include: low rise residential, high rise residential, commercial, industrial, institutional, and places of assembly. The Arthur D. Little Company studied the energy savings that can be achieved by the use of 90-75. The study showed a 27% energy saving if sections 4 through 9 are implemented. The budget approach advocated by AIA and the problems of budget standards are briefly mentioned. In summation, there are two ways to proceed, i.e., prescriptive or performance. Performance standards are preferred, but both will save energy.

29228 Rational model for thermodynamic analysis of occupied spaces. Mehta, D.P. (Bradley Univ., Peoria, IL); Brueck, D.M.; Woods, J.E. pp 2.3-2.28 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

It has been shown that a simple model allows analysis of interactions between a number of design parameters for HVAC systems. A refined model has been derived to which the theory of sensitivity can be applied. Solution of the sensitivity equation has also been shown to be possible. The refined model has been presented in a form in which the analytical models of other elements in a control loop can be coupled to produce an overall transfer function for the building system. Classical control techniques as well as modern control theory techniques, such as stability and optimization, can be applied to guide the designer of building systems. It is hoped that the application of these techniques will play a major role in the design of energy efficient building systems in years to come.

29229 Building Energy Management Index: methods of calculation and application. Reynolds, G.; Woods, J.E. (Iowa State Univ., Ames). pp 2.29-2.46 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The Building Energy Management Index (BEMI) was developed at Iowa State University in order to provide the building owner or manager with an energy monitoring model that supplies energy use key elements. A graphical procedure is presented which provides visual interpretation of this performance and which provides feedback for energy management decision. Further, a graphical technique is introduced which allows energy consumption performance comparisons against other buildings within the same functional category. A definition of excessive energy consumed (EES), based upon this functional category comparison test, is supplied and a simple economic analysis is presented which provides insight into the magnitude of the energy conservation program investment. Proposed investigations for model refinement and further predictive modeling are suggested. The BEMI is a versatile index, capable of characterizing building energy performance and providing necessary information for important energy decisions.

29230 Impact of energy management on architecture. Buehrer, H. (Buehrer and Stough, Associates, Toledo, OH). pp 3.3-3.20 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

It is shown that the traditional role of the architect must change. No longer may the architect design buildings without integrating the mechanical and lighting systems into the early schematic design phase. A comparison is made of energy conservation opportunities in existing and new buildings. AIA has stated that the energy usage of existing buildings can be reduced from 25 to 50% by retrofitting, and that energy usage in new buildings can be reduced from 50 to 80% by previous design. If all existing buildings were retrofitted by 1990, energy usage in the built environment could be reduced by 39%. Some examples to verify these observations are presented.

29231 Blowing cellulose fiber into sidewalls containing batts of insulation. Bern, C.J.; Roth, F. (Iowa State Univ., Ames). pp 4.47-4.62 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The procedure for blowing cellulose into previously insulated sidewalls was investigated. A total of 34 tests were conducted. The procedure is described. It is concluded that stud spaces containing batts up to 2.5 inches thick can be blown full of cellulose fiber insulation. Placement of cellulose insulation in walls containing 3.5 inch-thick batts is difficult, and void regions may result. Placement of cellulose insulation against the faced side of a batt facilitates filling. Crumpled batts (of any thickness) impede cellulose insulation flow, and void regions may result. Blowing cellulose through top and bottom holes, in turn, minimizes the extent of the void regions. Under conditions similar to those of this study, compression of glass fiber resulting from cellulose placement enhances its insulative value (per inch of thickness). Under conditions similar to those of this study, blowing cellulose insulation through one hole near the top (with an air hole beside it), or through bottom and top holes, in turn, all result in total filling and in similar flow rates and final bulk densities provided that the stud space is void or contains uncrumpled batts not thicker than 2.5 inches.

29232 Canadian viewpoint on energy management. Handegord, G.O. (National Research Council, Ottawa, Canada). pp 4.63-4.73 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The Associate Committee on the National Building Code of the National Research Council of Canada issued a document entitled Measures for Energy Conservation in New Buildings in 1978. It was based on ASHRAE 90-75, with modifications to adapt requirements to Canadian conditions and a slightly different approach in some key areas. Both the Canadian measures and the ASHRAE make a distinction between two classes of buildings. The basis for this distinction, however, is slightly different in each case. Some specifics of these energy requirements and budgets are cited. The Canadian measures for energy conservation in new buildings have been produced as a model document and have no force in law until adopted by an authority having jurisdiction. In Canadian constitutional arrangements this lies with the provinces. However, the provinces will probably have final authority in determining the energy measures and requirements for buildings built in their jurisdictional area.

29233 Energy and economic analysis. Spielvogel, L.G. (Lawrence G. Spielvogel, Inc., Wyncote, PA). pp 6.3-6.41 of Proceedings

of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The various types of energy calculations used for making economic analyses of energy-related alternatives in buildings are discussed. Calculations for new and existing buildings are described. The techniques for calculating energy consumption and the relative accuracy and precision to be obtained by the use of these techniques are explored. In Chapter 43 of the 1976 ASHRAE Handbook, three basic techniques utilized for energy calculations are described. These are the degree day method or single measure method; the bin or multiple measure method; and hourly calculation techniques. It becomes necessary to make economic analyses to decide which of the alternatives and to what extent those alternatives are to be employed in any new or existing building. For the purpose of decision making, these results are grouped into categories dealing with payback periods. It is concluded that generalized analyses and rules of thumb cannot be utilized for making energy and economic analyses.

29234 Energy efficient comfort system for multi-room buildings. Laube, H.L. pp 7.23-7.36 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

In order to determine the most economical comfort system for a multi-room building, a comparison was made of energy loss in the two systems, both serving identical large structures. The first building will have a traditional dual-fuel central system; one that uses local combustion of fossil fuel for heat, together with a water chiller and auxiliaries driven by electricity generated by the remote combustion of fossil fuels. For the second building a packaged terminal air conditioner employing hermetically sealed, self-contained, air-cooled refrigeration cycles, combined with electric resistance heating elements for all office space, with larger package equipment for ground floor shops is used. The packaged terminal air conditioners would be located around the perimeter of all office floors, but would serve both the perimeter and core areas. Both structures are assumed to be 20-story office buildings in Chicago. The study shows that the decentralized system requires far less useless energy than does the central system when measured within the building line. The corollary to this is: the larger the building the less, proportionately, is the waste. But it is fossil fuel that needs to be saved. The meaningful comparison between the two systems requires that electricity used by both systems be converted into fossil energy equivalents.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 29168, 29247

29235 (CONF-800111—4) **Concentrated vs. distributed energy: employment based community level differences.** Hoover, L.J.; Santini, D.J.; Smeltzer, K.K.; Stenehjem, E.J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01.

From Annual conference of the American Association for the Advancement of Science; San Francisco, CA, USA (4 Jan 1980).

Consideration is given to the differences between concentrated options (central station electric, synfuels) and distributed options (SHACOB) for residential space conditioning. Employment, geographic location, community stability, and locational equity are the factors discussed.

29236 (DOE/CS—0166) **Engineering analysis.** (Department of Energy, Washington, DC (USA). Office of Buildings and Community Systems). Jun 1980. 265p. NTIS, PC A12/MF A01.

In order to assess the benefits and impacts of setting standards for minimum efficiencies at different levels based on the seven criteria specified in Section 325 of Energy Policy and Conservation Act P.L. 94-163 and amended by the National Energy Conservation Policy Act, a technical and economic analysis was completed for each product type (refrigerators, freezers, water heaters, furnaces, boilers, clothes dryers, kitchen ranges and ovens, central and room air conditioners). The relationship between the cost of a consumer product and its efficiency (cost-efficiency curve) was estimated for each product class based on engineering analyses. The basis for these relationships is presented. Combinations of design improvements available on units currently offered for sale were used to generate cost-efficiency relationships that became inputs to other analyses of the impact of setting standards at various efficiency levels. In addition, estimates were made of the maximum technologically feasible energy efficiency level which could be achieved by 1986. These lvels were based on engineering analysis and no estimates were made of the cost of implementing these technologies. The general methodology used in making these estimates and the details of the analysis by product type are presented.

29237 (DOE/CS—0168) **Environmental assessment. Energy efficiency standards for consumer products.** (Department of Energy, Washington, DC (USA). Office of Buildings and Community Systems). Jun 1980. 137p. NTIS, PC A07/MF A01.

The Energy Policy and Conservation Act of 1975 requires DOE to prescribe energy efficiency standards for 13 consumer products. The Consumer Products Efficiency Standards (CPES) program covers: refrigerators and refrigerator-freezers, freezers, clothes dryers, water heaters, room air conditioners, home heating equipment, kitchen ranges and ovens, central air conditioners (cooling and heat pumps), furnaces, dishwashers, television sets, clothes washers, and humidifiers and dehumidifiers. This Environmental Assessment evaluates the potential environmental and socioeconomic impacts expected as a result of setting efficiency standards for all of the consumer products covered by the CPES program. DOE has proposed standards for eight of the products covered by the Program in a Notice of Proposed Rulemaking (NOPR). DOE expects to propose standards for home heating equipment, central air conditioners (heat pumps only), dishwashers, television sets, clothes washers, and humidifiers and dehumidifiers in 1981. No significant adverse environmental or socioeconomic impacts have been found to result from instituting the CPES.

29238 (DOE/CS—0170) **Certification/enforcement analysis.** (Department of Energy, Washington, DC (USA). Office of Buildings and Community Systems). Jun 1980. 396p. NTIS, PC A17/MF A01.

Industry compliance with minimum energy efficiency standards will be assured through a two-part program approach of certification and enforcement activities. The technical support document (TSD) presents the analyses upon which the proposed rule for assuring that consumer product comply with applicable energy efficiency standards is based. Much of the TSD is based upon support provided DOE by Vitro Laboratories. The OAO Corporation provided additional support in the development of the sampling plan incorporated in the proposed rule. Vitro's recommended approach to appliance certification and enforcement, developed after consideration of various program options, benefits, and impacts, establishes the C/E program framework, general criteria, and procedures for assuring a specified level of energy efficiency performance of covered consumer products. The results of the OAO analysis are given in Volume II of the TSD.

29239 (LBL—10960) **International residential energy use and conservation analysis: structural and economic data base.** Schipper, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 75p. NTIS, PC A04/MF A01.

Compilations on demographic, economic, and housing data for Canada, France, Federal Republic of Germany, Italy, Japan, Sweden, and the United Kingdom are presented. Demographic and economic data covering population, personal disposable income, expenditures, and employment status are given for the years 1960 to 1978. The housing stock data for each country contains information on housing stock totals (additions, size, retirements); single family dwellings total; multi-family dwelling totals; and the residual total. Explanations are given for the derivation of the totals.

29240 (NMEI—78-1124) **Development of retrofit energy conservation systems. Final report, July 1, 1978-September 31, 1979.** Edgel, W.R. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Dec 1979. 141p. Univ. of New Mexico, New Mexico Energy Inst., Albuquerque.

The potential for space heating energy conservation available through retrofitting existing buildings is much greater than that arising from energy conscious construction of new buildings. This mandates development of energy and cost effective retrofit energy conservation systems for existing buildings. This report describes a feasibility study of what can be done for existing buildings and how energy and cost effectively it can be done. The study consists of a survey of existing buildings in New Mexico; a survey of retrofit energy conservation systems being used already; a design study of thermal envelope improvements, furnace modifications, solar heating systems, and fireplaces or wood stoves; and a performance and cost analysis which assesses the relative energy and cost effectiveness of the various retrofits.

29241 Evaluation, 1979: a look at conservation projects and activities at Seattle City Light. Seattle, WA; Seattle City Light (1980). 221p. (NP—24454).

The attempt at systematic evaluation of energy conservation activities and programs at Seattle City Light is reviewed. In 1979, 22 projects/activities were evaluated and categorized in-house, i.e., commercial/industrial; residential; outreach efforts;support activities; (not targeting the public); research, development, and demonstration; and in-house conservation activities. Details of each of these projects are presented. Four studies conducted by outside consul-

tants are: Evaluation of the Seattle City Light Neighborhood Energy Conservation Program (Battelle Institute); Seattle City Light Conservation Office Evaluation Plan Review (Communication Design); Residential Customer Conservation Attitude and Awareness Study (Communication Design); and A Case Study of Seattle City Light's Utility/Bank/Contractor Insulation Program (Brown and Caldwell). Summaries of the reports are included as appendices.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

29242 Ventilation induced energy conservation in laboratory animal facilities. Southards, W.T. (Babcock and Wilcox, Co., Alliance, OH); Ingley, H.A.; Besch, E.L. pp 2.47-2.67 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

Ventilation requirements for laboratory animal facilities are energy intensive. This partly is due to the requirement for 10 to 15 air changes per hour of 100% outside air, dry bulb temperature control between 18.4 to 29.5°C (+- 1°C), and humidity control between 30 to 70% R.H. Also, ventilation of animal facilities is based on continuous, 24 h/day operation and independent of animal (heat) load. Weather data from selected geographic locations in the US were compared with proposed modifications in management and applications of currently available heat conserving methods to existing animal storage units. The resultant analyses indicate that significant ventilation-induced energy savings may be realized. However, the health and well-being of the animal must dictate which management or design techniques are feasible.

29243 Systems and controls design for energy conservation. Sepsy, C.F. (Ohio State Univ., Columbus). pp 5.3-5.24 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The energy conservation project at Ohio State University to increase the operating efficiency of the campus buildings without interfering with the functions of the occupants is described. The project consisted of a complete building survey and preparation of a report containing suggested energy saving modifications to the building along with estimated construction cost savings. Modifications, which primarily are funded based on the estimated payback periods, were then implemented. Metered utility consumption was taken after implementation and compared to consumption of previous years to verify the savings estimated. The study of the Allied Medical Facilities Building is specifically described.

29244 Case study in energy saving: Pacific Telephone Central Office Bldg., Newhall. Holladay, W.L. (Carter Engineers, Garden Grove, CA). pp 7.3-7.13 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

An energy conservation program in the Pacific Telephone Central Office Building in Newhall is described. Its total floor area is slightly less than 50,000 sq ft in two stories and a basement. Data for operating its air conditioning systems and descriptions of the cooling systems are given. Measures to operate the systems efficiently and energy-saving modifications are described and it is estimated that the expenditure recommended for this building will result in a 53% return a year at present rates.

29245 Energy management in a corporate office building. Hayter, R.B. (Energy Management and Control Corp., Topeka, KS); Lindsey, R. Jr. pp 7.15-7.22 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The energy management study for the Kansas Area Headquarters Building of Southwestern Bell, located in Topeka, is described. The plan includes recommendations for operational and system modifications with a projected payback period not to exceed 2 1/2 years. Where thermal modifications were considered, the potential savings were estimated using a bin analysis modified to include dual duct and economizer dampers. This permitted the study of volumetric flow rates through the fresh air dampers, hot deck, cold deck, and building exhaust, as well as the potential for energy recovery. Major modifications have been released for bid and actual savings cannot be compared to that projected.

29246 (DOE/R5/10160—2) Final project report from La Crosse, Wisconsin YW/YMCA. (La Crosse, WI, YW/YMCA (USA)). [nd]. Contract FG02-79R510160. 4p. NTIS, PC A02/MF A01.

The energy recovery project at the La Crosse YW/YMCA building is described. A coil heat recovery loop system was designed to recover from warm exhausted air heat that would pre-heat the incoming cold air.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 29241

29247 Office of Conservation 1979 annual report. Seattle, WA; Seattle City Light (1979). 45p. (NP—24455).

Seattle City Light Conservation Program activities commenced in 1979 with a mandate for increased emphasis on the commercial/industrial end-use sector. The other five major project categories: residential, outreach, in-house conservation, research, development, and demonstration; and support activities also achieved milestones relating to their project tasks. For the progress made in all activities in each category, information is summarized on Project yearly activity, goal, objectives, highlights of 1979 activity, highlights of activity to date, and cost to date.

29248 Greater Auckland commercial sector energy analysis. Shaw, R.A. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 44p. (NZERDC—45).

A major field survey of 707 commercial buildings (on 606 properties) has been completed in the Greater Auckland region, which comprises 25% of New Zealand's population. Detailed physical and energy relevant data have been recorded. Energy consumption information (electricity, oil, gas, and coal) for 1977 has ben obtained from Energy Supply Authorities. Raw survey data have been computer processed. Survey results have been extrapolated using known floor space totals to provide estimates of gross data for Greater Auckland. Installed plant and energy consumption (split by mode) totals are given. These data are presented initially from both building and tenant viewpoints, disaggregated into nine major use categories. Derived energy indices (Area Energy Use Index, Volume Energy Use Index, plant density, and utilization factor) are presented. The same parameters are also disaggregated by age and size range categories. Total commercial sector floor space is 6,330,300 m^2. Annual gross energy consumption is estimated at 2,732 TJ. Use category is the most important determinant of energy use. Buildings constructed in the 1960's appear to have significantly higher consumption than all other age groups. There is a definite indication that buildings over 3,000 m^2 have increased energy intensiveness. Basic statistics on incidence of centralized space conditioning installations are given. Frequency distributions of Area Energy Use Index and gross energy consumption are also described. This report does not include a New Zealand wide extrapolation of the Survey Data. The variability of energy use in the commercial sector which is exposed as a result of the survey clearly indicates the need for caution in such an extrapolation.

29249 Automated energy management systems (AEMS) for small buildings. Lane, R.D.; Carlson, D.N. (Honeywell, Inc., Minneapolis, MN). pp 4.3-4.30 of Proceedings of the building energy management conference. Woods, J.E.; Peterson, P.W.; Welch, R.E. (eds.). Ames, Iowa; Iowa State University (1978).

From Building energy management conference; Ames, IA, USA (30 Oct 1978).

The US Department of Energy (DOE) is committed to the development, demonstration, and implementation of cost-effective energy conserving control systems for heating, ventilating, air conditioning, lighting, and refrigeration systems in commercial and residential buildings. A program was undertaken to identify the potential for energy conservation through development and use of cost-effective Automated Energy Management Systems (AEMS) for small commercial buildings. From a macroscopic viewpoint, widespread usage of an AEMS in small buildings has the potential to save a considerable amount of the nation's energy. Small commercial buildings (under 75,000 ft^2) consume a significant portion - approximately 10.5% - of the nation's energy. The study emphasized consistency with national energy policy objectives. It concentrated on identifying sectors of the commercial building community wherein the largest potential for near-term energy savings for the nation could be realized through the availability of an AEMS.

TRANSPORTATION

REFER ALSO TO CITATION(S) 29224

RAILWAY

29250 (CONF-800486—1) Effect of a sudden fuel shortage on freight transport in the United States: an overview. Hooker, J.N. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

From National energy users conference for transportation; San Antonio, TX, USA (13 Apr 1980).

A survey was made of the potential effects of a sudden reduction of fuel supplies on freight transport via truck, rail, water, and pipeline. After a brief discussion of the energy characteristics of each of these modes of transport, short-term strategies for making better use of fuel in a crisis are investigated. Short-term is taken to mean something on the order of six months, and a crisis is taken to be the result of something on the order of a 20% drop in available fuel. Although no succinct or well-established conclusions are drawn, the gist of the paper is that the potential for short-term conservation, without a serious disruption of service, exists but does not appear to be large. It is remarked that it is possible, through further study, to obtain a fairly accurate reckoning of the physical ability of the freight transport network to weather a fuel crisis, but that it is impossible to say in advance what freight carriers will in fact do with the network.

29251 (LBL—10636(Draft2)) **Locomotive data acquisition package phase II system development. Final report. Volume 2. LDR operations and maintenance.** Abbott, R.K.; Kirsten, F.A.; Mullen, D.R.; Sidman, S.B.; Miller, J.G.; Ng, L.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 108p. NTIS, PC A06/MF A01.

An examination of the problems associated with railroad locomotive data acquisition is presented. The design of a minicomputer based locomotive data acquisition system is also presented. Special attention is placed on meeting the functional characteristics and environmental specifications required for the system. The system described consists of a magnetic tape digital data recorder, an ensemble of transducers, and analysis software. The system described is to be used as a research tool. This volume discusses the operation and maintenance of the Locomotive Data Recorder (LDR).

29252 (SAN—1176-T5) **Fuel conservation opportunities through changes in mode of freight transportation. Final report.** Corbett, R.M.; Moon, A.E. (SRI International, Menlo Park, CA (USA)). Jun 1979. Contract EY-76-C-03-1176. 53p. NTIS, PC A04/MF A01.

The study identifies opportunities for and barriers to increased use of railroads to promote fuel conservation. Transportation officials were interviewed from 9 companies in the processed food, metals, chemicals, and transportation vehicle industries. These industry personnel identified unreliable delivery times and equipment shortages as the key issues in their decision not to use the railroads. A range of actions that railroad management could take to improve transit time reliability is identified. Barriers to implementing changes include (in increasing order of difficulty) changes in operating practices, capital outlays, increased operating costs, and changes in work rules. Ranked by increased order of difficulty to implement actions to improve reliability are as follows: rationalize train schedules, yard crew assignments in terminal areas, system blocking plan, and configuration of complex terminal areas; schedule freight cars from door to door; and operate freight trains more frequently.

29253 (UMTA-MA—06-0049-80-1) **Transit fare prepayment demonstrations in Austin, TX and Phoenix, AZ.** Bloomfield, P.; Crain, J. (Crain and Associates, Menlo Park, CA (USA)). Jun 1979. 308p. NTIS.

Two matched demonstration projects testing transit fare prepayment innovations in Austin, Texas and Phoenix, Arizona were conducted. The innovations consisted of two consecutive sales of prepaid tickets and passes at discounts of 20% and 40%, accompanied by expansion of sales outlet networks and intensive advertising and promotional campaigns. The demonstrations measured the impacts of these innovations on: (1) the volume and mix of sales of the various transit fare prepayment instruments, (2) transit-riding levels, and (3) transit costs and operations. In addition, special attention was to be given to evaluating the relative cost-effectiveness of the special advertising and promotional campaigns conducted in both sites. Although beyond the scope of the demonstrations, some evaluation information was obtained on the cost and effectiveness of regular transit fare prepayment programs, in their role as adjuncts to transit service.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 29250, 29253

29254 (DOE/CS/10305—T1) **Conservation in transportation.** (Fraser/Associates, Washington, DC (USA)). 30 May 1980. Contract AC01-80CS10305. 63p. NTIS, PC A04/MF A01.

A nationwide examination was made of grassroots energy conservation programs related to transportation. Information compiled from civic groups, trade associations, and corporations is included on driver awareness/mass transit; travel; and ride sharing. It is concluded that a willingness by the public to cooperate in transportation energy conservation exists and should be exploited. (LCL)

29255 (UMTA-MA—06-0049-80-6) **Accessible bus service in St. Louis. Final report. UMTA/TSC project evaluation series.** Teixeira, D.; Varker, F.; Bowlin, R. (Applied Resource Integration Ltd., Boston, MA (USA)). Feb 1980. 346p. NTIS.

The Bi-State Development Agency in St. Louis began operating buses equipped with hydraulic lifts for boarding persons in wheelchairs in August of 1977. This was the first large scale accessible bus project in transit history. One hundred fifty-seven lift equipped buses were put into revenue service over a three and one-half month period. Seventeen routes were selected for accessible bus service. In September of 1978, scheduled accessible service was cut back by two-thirds due to malfunctions of the lift equipment. Wheelchair user ridership decreased gradually during the first year of service but dropped off markedly during the last ten months of the evaluation period. The evaluation covered the development planning, the implementation process, operations, service and equipment reliability, travel behavior, productivity, economics, and service impacts. The results of the St. Louis accessible service which have important implications for other operators are also discussed.

SEA AND WATER

REFER ALSO TO CITATION(S) 29250

PIPELINE

REFER ALSO TO CITATION(S) 29250

29256 **Optimizing NO/sub x/ control in energy-efficient industrial systems.** Bojko, R.C.; Mattis, R.P. Chicago, IL; Institute of Gas Technology (1980). 16p. (CONF-800608—3).

From Air Pollution Control Association annual meeting; Montreal, Canada (Jun 1980).

Methods most suited for controlling NO/sub x/ from industrial gas-burning furnaces, particularly those furnaces whose operation would make preheat feasible, are discussed. These methods include low excess air (LEA) firing and flue-gas recirculation (FGR). The results of this study showed that increasing LEA firing (increasing the amount of excess air) increases NO/sub x/ formation and decreases fuel savings. Increasing combustion air temperature increases NO/sub x/ formation and increases fuel savings. However, increasing recuperator inlet gas temperature increases fuel savings only. Also, implementing FGR decreases both NO/sub x/ formation and fuel savings; preheating combustion air increases both NO/sub x/ formation and fuel savings; and increasing recuperator inlet gas temperatue increases fuel savings without affecting NO/sub x/ formation. It is concluded that despite its adverse effects on NO/sub x/ formtion, the use of hot flue-gas products to conserve energy is a very real solution to the energy problem. Of the control techniques examined, LEA firing stands out as being very effective in terms of NO/sub x/ formation and fuel savings; it is capable of reducing NO/sub x/ and increasing thermal efficiency at a fairly low cost. FGR, however, is a costly venture because high-temperature fans and ducts, along with sufficient space, are necessary. Although it has been concluded that FGR reduces thermal NO/sub x/, recent experience has cast doubts on its capability to reduce fuel NO/sub x/. In an effort to minimize NO/sub x/ formation and maximize fuel savings, it has been established that NO/sub x/ formation is influenced by the combustion air temperature and the NO/sub x/ control technique, while fuel savings depends on combustion air temperature, the No/sub x/ control technique, the recuperator inlet gas temperature, and the recuperator itself.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 29166, 29241, 29247

ENERGY SOURCES

29257 **Review of energy use in New Zealand agriculture.** Smith, D.J.; McChesney, I.G. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 21p. (NZERDC—48).

New Zealand's agricultural system shows a net return of energy at the farm gate, but the ratio of food energy returned to auxiliary energy invested is so small that there is a need to be seriously concerned on two counts. First, the rest of the food production system, comprising processing, distribution and preparation, consumes sufficient additional energy that the overall energy ratio is less than 1:1. Counter to the trend towards increased energy consumption in agriculture will be those savings that may result from the development of animal breeds, crop varieties, and cultural practices that make more efficient use of the solar and auxiliary

energy inputs. In all production systems involving the harvesting of biological materials, several critical parameters (energy ratio, energy intensity, energy productivity, and net energy yield) describe energy use. The consideration of these parameters along with socio-economic criteria should be incorporated into planning for the future development of such production systems. The changes which would most favorably alter the food-production system as a whole, i.e., alteration of diet, changes in product mix in favor of grains and pulses, and increased emphasis on genetic research, are unfortunately those least likely to receive attention. Dietary patterns change only slowly, farmers are reluctant to modify traditional methods of farming and to grow new crops, and the development of new breeds of animals and varieties of crops is time-consuming and costly. Nevertheless, such changes will have to be made if the food-production system is to adapt effectively to the challenges ahead.

29258 Cogeneration of heat and electricity in a meat works. Furness, J.B.; Pearson, R.G. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 43p. (NZERDC—50).

A feasibility study of cogeneration of heat and electricity at the Belfast complex of The Canterbury Frozen Meat Company Limited is presented. When the study commenced an early decision on boiler replacement was anticipated. A thorough energy survey of the two freezing works involved revealed methods of redistributing steam loads to reduce peak steam demand. These are now being carried out. In addition, a decision has been made to spend $1.6 million to increase throughput of the rendering plant by using a more energy-efficient process. The result of these steps is that the existing boilers can cope with steam demands for the next 5 to 10 years. Because only solid fuels are available in the South Island, any cogeneration system at Belfast would involve steam turbine-driven generators and new high pressure boilers. It has been found that no cogeneration system is economic unless it accompanies the installation of a new boiler. In CFM's case, therefore, cogeneration is a long-term prospect. While cogeneration cannot be seriously contemplated at present, a number of hypothetical systems have been designed on the basis of boiler replacement. No serious technical difficulty is foreseen, provided reasonable co-operation is forthcoming from the public electricity authorities. The hypothetical systems designed have been assessed for economic return and have been found unattractive for private enterprise investment. Benefits of cogeneration, principally fuel conservation, accrue to the nation but not to the owner and operator of a system. A range of possible incentives have been analyzed. The most attractive appears to be a direct subsidy for the electricity produced by cogeneration. It is recommended that this be seriously considered by the Ministry of Energy, and also that an equitable cogeneration tariff be adopted by local supply authorities.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 29258, 29508

29259 (DOE/CS/40264—T1) **Energy conservation by hyperfiltration: food industry background literature survey.** (Carre, Inc., Seneca, SC (USA)). 15 Apr 1980. Contract AC03-79CS40264. 54p. NTIS, PC A04/MF A01.

The application of hyperfiltration to selected food product streams and food processing wastewaters for energy conservation was examined. This literature survey had led to the following conclusions: no research has been conducted in the food industry using membranes with hot process streams due to the temperature limitation (< 40°C) of the typically studied cellulose acetate membranes; based on the bench-scale research reviewed, concentration of fruit and vegetable juices with membranes appears to be technically feasible; pretreatment and product recovery research was conducted with membranes on citrus peel oil, potato processing and brine wastewaters and wheys. The experiments demonstrated that these applications are feasible; many of the problems that have been identified with membranes are associated with either the suspended solids or the high osmotic pressure and viscosity of many foods; research using dynamic membranes has been conducted with various effluents, at temperatures to ~ 100°C, at pressures to 1200 psi and with suspended solids to ~ 2%; and, the dynamic membrane is being prototype tested by NASA for high temperature processing of shower water. The literature review substantiates potential for dynamic membrane on porous stainless tubes to process a number of hot process and effluent streams in the food processing industry. Hot water for recycle and product concentrations are major areas with potential for economic application. The two plants involved in the first phase of the project should be reviewed to identify potential energy conservation applications. As many as possible of the conservation applications should be tested during the screening phase at each site. The most promising applications at each site should be evaluated more intensively to establish engineering estimates of the economics of this technology for the canned fruit and vegetable segment of the food industry.

29260 (ORNL/TM—7284) **Effects of alternate fuels refractory test facility test 3. Part 2. Analysis of magnesia- and alumina-based dense refractories exposed to the combustion products of No. 6 residual oil.** Federer, J.I.; Tennery, V.J. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 66p. NTIS, PC A04/MF A01.

Industrial conversion from natural gas to residual oil or coal for process heating generally accelerates deterioration of refractories because of reactions with fuel impurities. This investigation was the third experiment to determine the nature and extent of degradation reactions between fuel impurities (in combustion products) and constituents of the refractories under controlled combustion conditions. The dense refractories included three magnesia-based bricks, a chrome mortar, three alumina-based bricks, and three alumina-based castables. These specimens were exposed to the combustion products of a medium-sulfur No. 6 oil at a hot-face temperature of 1350°C for 1002 h with 7 to 10% excess oxgyen. The furnace was cycled 18 times between 500 and 1350°C. The specimens were analyzed by ceramography, electron microprobe analysis, and x-ray diffraction. Some specimens contained cracks originating at the hot face. The magnesia-based bricks evidently contained a network of small cracks, since they fragmented easily. Cracking was caused by excessive cooling rates from 1350°C when equipment failure caused unscheduled furnace shutdowns. All the specimens were discolored. The depth of the colored zone from the hot face increased with decreasing alumina content in the alumina-based refractories. Fuel impurities were detected on the hot faces and in some specimens in various phases near the hot face; however, new phases involving fuel impurities were definately identified only in two alumina-based bricks. We concluded that no significant degradation of the refractorie due to impurity-related phase formation occurred under the conditions of this test because the oil contained relatively low concentrations of impurities. This fuel, therefore, was not very agressive in degrading the refractory specimens.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 28627, 29182, 29195, 29210, 29256

29261 (DOE/ET/11343—T1) **Evaluation of fluid bed heat exchanger optimization parameters. Final report.** (Aerojet Energy Conversion Co., Sacramento, CA (USA)). Mar 1980. Contract AC03-78ET11343. 223p. NTIS, PC A10/MF A01.

Uncertainty in the relationship of specific bed material properties to gas-side heat transfer in fluidized beds has inhibited the search for optimum bed materials and has led to over-conservative assumptions in the design of fluid bed heat exchangers. An experimental program was carried out to isolate the effects of particle density, thermal conductivity, and heat capacitance upon fluid bed heat transfer. A total of 31 tests were run with 18 different bed material loads on 12 material types; particle size variations were tested on several material types. The conceptual design of a fluidized bed evaporator unit was completed for a diesel exhaust heat recovery system. The evaporator heat transfer surface area was substantially reduced while the physical dimensions of the unit increased. Despite the overall increase in unit size, the overall cost was reduced. A study of relative economics associated with bed material selection was conducted. For the fluidized bed evaporator, it was found that zircon sand was the best choice among materials tested in this program, and that the selection of bed material substantially influences the overall system costs. The optimized fluid bed heat exchanger has an estimated cost 19% below a fin augmented tubular heat exchanger; 31% below a commercial design fluid bed heat exchanger; and 50% below a conventional plain tube heat exchanger. The comparisons being made for a 9.6 x 10^8 Btu/h waste heat boiler. The fluidized bed approach potentially has other advantages such as resistance to fouling. It is recommended that a study be conducted to develop a systematic selection of bed materials for fluidized bed heat exchanger applications, based upon findings of the study reported herein.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 28361, 28556, 28574, 29270, 29629

29262 Salt-soda sinter process for recovering aluminum from fly ash. McDowell, W.J.; Seeley, F.G. US Patent Application 024,339. [nd]. 10p.

A method for recovering aluminum values from fly ash comprises sintering the fly ash with a mixture of NaCl and Na_2CO_3 to a temperature in the range 700° to 900°C for a period of time sufficient to convert greater than 90% of the aluminum content of the fly ash into an acidsoluble fraction and then contacting the thus-treated fraction with an aqueous solution of nitric or sulfuric acid to effect dissolution of aluminum and other metal values in said solution.

29263 (BM-RI—8428) **Recovery of silver from chloride leach solutions by iodide precipitation.** Carnahan, T.G.; Flynn, C.M. Jr.; Lindstrom, R.E. (Bureau of Mines, Reno, NV (USA)). 1980. 12p. Bureau of Mines, Washington, DC.

The Federal Bureau of Mines investigated, on a laboratory scale, a technique for recovery of silver from pregnant solutions generated in the hydrometallurgical treatment of complex base-metal sulfide concentrates with oxidizing chloride media. This technique provides a means for recovery and simplified reduction of accessory silver to metal from chloride solutions. The method consists of adding NaI or KI to the solution to precipitate AgI, which is then contacted with Na_2S to produce Ag_2S and to regenerate the iodide salt soluton. Silver recoveries range from 99% with 20% excess iodide precipitant, to 92% when the theoretical stoichiometric amount of precipitant is employed. The Ag_2S product can be reduced to silver metal by contact with aluminum chips in NaOH solution followed by purification with conventional fire refining techniques.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 29219

29264 (CONS—4212-T1) **Energy-conserving site-design case study, Radisson, New York. Appendix.** (Reimann-Buechner Partnership, Syracuse, NY (USA)). Dec 1979. Contract EM-78-C-01-4212. 102p. NTIS, PC A06/MF A01.

Materials included in this Appendix to Final Report to CONS-4212-T2) provide support and background data for the body of that report. Data selected for inclusion are intended to provide background analysis or to clarify methodology. In most instances, the Appendix information is referenced to the body of the final report. Sections are devoted to: climate; building design data;energy-simulation data; and resources and contracts. 36 references.

29265 (CONS—4212-T2) **Energy-conserving site-design case study, Radisson, New York. Final report.** (Reimann-Buechner Partnership, Syracuse, NY (USA)). Dec 1979. Contract EM-78-C-01-4212. 155p. NTIS, PC A08/MF A01.

Radisson is a 2,950-acre new community currently being developed by the New York State Urban Development Corporation and located in central New York, 12 miles north-west of Syracuse. Case-study sites selected for this project are a 95-acre residential site and the 51-acre Town Center of the new community. Development on the Residential Site is a low-density (2.8 dwelling units/acre) mixture of single-family, townhouse and multi-family units. Development on the Town Center site is a mixture of small-scale commercial use (144,000 sq. ft.) and 330+ multi-family dwelling units. Energy-conserving plans developed for both sites have focused on passive measures to reduce energy use for space heating. Utility-system options have been identified for both sites, but require further study as to feasibility and cost. This report summarizes energy savings and cost differentials due to passive measures incorporated in both the residential and Town Center Plans. The future implementation schedule, also discussed, summarizes the procedures an schedule required for implementation of the passive measures, as well as further study required for the development of utility-system options. 4 tables.

29266 (CONS—4214-T1) **The Woodlands Metro Center energy study. Case studies of project planning and design for energy conservation.** (The Woodlands Development Corp., TX (USA)). Mar 1980. Contract EM-78-C-01-4214. 164p. NTIS, PC A08/MF A01.

The Woodlands is a HUD Title VII New Town located near Houston, including 22,000 acres; the plan for the new town consists of 6 residential villages, a town center (Metro), and a Trade Center for larger-scale industrial use. Included within the program for each village are schools and commercial activities, as well as employment activities. The Woodlands is planned to be developed over a 26-year period (commenced in 1972) with an ultimate population of 150,000. Following a summary chapter, Chapter II presents background material on The Woodlands and results of the study are summarized. Chapter III describes the project team and its organizational structure. Chapter IV outlines and documents the methodology that was employed in developing, analyzing, and evaluating the case study. The next chapter describes and analyzes the conventional plan, documents the process by which energy-conserving methods were selected, and evaluates the application of these methods to the Metro Center Study area. Chapter VI discusses constraints to implementation and is followed by a final chapter that presents the general conclusions from the case study and suggests directions for further investigation.

29267 (CONS—4214-T1(App.1)) **The Woodlands Metro Center energy study. Case studies of project planning and design for energy conservation.** (The Woodlands Development Corp., TX (USA)). Mar 1980. Contract EM-78-C-01-4214. 295p. NTIS, PC A13/MF A01.

Appendix I for The Woodlands Metro Center Energy Study near Houston consists of a computer model (Program ENERCALC) for parcel level analysis (data sources and definitions, ENERCALC Program description, assumptions, and variables evaluated for Energy Plan); computer model results of Program ENERCALC (conventional plan and energy plan); life cycle cost analysis and energy savings by building type; summary of energy savings and costs; application of building envelope and site design modifications (strategies and parcel-by-parcel application and estimated savings); and energy supply system payback calculations.

29268 (COO—4977/1(Vol.4)) **District heating and cooling systems for communities through power plant retrofit distribution network. Final report, September 1, 1978-May 31, 1979.** (Public Service Electric and Gas Co., Newark, NJ (USA)). Oct 1979. Contract EM-78-C-02-4977. 154p. NTIS, PC A08/MF A01.

This volume presents information on the institutional factors, i.e., legal and regulatory aspects, a preliminary economic analysis, and a proposal for future studies on retrofitting existing thermal power plants so that they can supply heat for district heating and cooling systems for communities. (LCL)

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 29201

29269 (ANL/CNSV-TM—33) **Development of a joint-cost allocation manual for integrated community energy systems. Phase II.** (Ernst and Whinney, Washington, DC (USA)). Apr 1980. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01.

The distribution of Integrated Community Energy Systems (ICES) project capital and operating costs among multiple ICES services is of prime concern for an ICES owner and/or operator. The maintenance of adequate revenues from individual services and the commercial viability of an ICES project is influenced significantly by the method chosen for cost allocation. An in-depth study is presented of the Alternative Justifiable Expenditure method (AJE). The advantages and disadvantages of the AJE are discussed and a framework is developed for application of the method to the thermal and electric services of an ICES plant. The method departs to some degree from the concepts and procedures used in the cost-of-service allocations by emphasizing the value of ICES services to ICES thermal and electric customers.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 28574, 28620, 29210, 29495

29270 (SAN—1470-T2(App.E)) **Development of a risk analysis model. Appendix E. 1,000 ton per day anaerobic digestion plant case study, Final report, October 1979.** (Dynatrend, Inc., Arlington, VA (USA)). Oct 1979. Contract EC-77-C-03-1470. 67p. NTIS, PC A04/MF A01.

The Department of Energy (DOE) is investigating processes for the recovery of energy from urban wastes, with the intention of determining how the barriers standing in the way of commercialization of these processes can be overcome. Commercialization of any urban waste energy recovery process is constrained by many complex, uncertain components and interactions. Technical, economic, and institutional barriers presently exist which increase both the real and perceived risks of making such a venture commercially feasible. Current risks applicable to processes of this type may be categorized as: performance and reliability of technology; capital, operating, and maintenance costs; recovered product quality and quantity; waste (feedstock) quality and quantity; and market (energy buyer) stability. Anaerobic digestion is a biological technique for the production of usable gases from urban waste which provides a degree of promise for producing energy in commercial quantities. A risk analysis methodology suitable for the use of DOE's Office of Buildings and Community Systems (BCS) was developed by Dynatrend Inc. The specific process analyzed was in experimental operation as a pilot plant in Pompano Beach, Florida.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

29271 (LA-UR—80-1633) **Numerical simulation of reactive flow in internal combustion engines.** Cloutman, L.D.; Dukowicz, J.K.; Ramshaw, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980.

Contract W-7405-ENG-36. 7p. (CONF-800661—1). NTIS, PC A02/MF A01.

From 7. international conference on numerical methods in fluid dynamics; Palo Alto, CA, USA (23 Jun 1980).

Multidimensional numerical simulations of the reactive fluid flow in an internal combustion engine cylinder are useful in helping engine designers obtain insight into the physical mechanisms governing efficiency and pollutant formation. A comprehensive numerical model for internal combustion engine cylinder simulations that has been developed at Los Alamos is described. The model is currently embodied in a two-dimensional (axisymmetric) computer code called CONCHAS-SPRAY. Work is in progress on a three-dimensional code with the same features.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 29274

DIESEL

29272 (BNL—27792) **Soot reduction in diesel engines by catalytic effects.** Sapienza, R.; Butcher, T.; Krishna, C.; Gaffney, J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-800553—2). NTIS, PC A02/MF A01.

From 4. workshop on catalytic combustion; Cincinnati, OH, USA (14 May 1980).

Recent tests at Brookhaven National Laboratory indicate that both small additions of alcohols to the fuel and the presence of platinum surfaces in the combustion chamber can reduce soot emissions in a diesel engine. These tests were conducted over a limited range of operation in a single cylinder CFR engine. Most of the testing was done using pure cetane as a fuel at constant speed and load. Possible major features of the reaction mechanisms for both fuel additives and surface catalyst effectiveness are presented.

29273 (DOE/ET/15320—T1) **Ceramic coatings on diesel engine components. Period covered: January 1979-August 1979.** Kvernes, I.; Lillerud, K.P. (Sentralinstitutt for Industriell Forskning, Oslo (Norway)). Oct 1979. Contract AC03-79ET15320. 19p. NTIS, PC A02/MF A01.

Diesel engines with imporved thermal efficiency and fuel economy or flexibility will be required to meet automotive energy conservation goals. These goals can be met by minimizing engine heat loss to the coolant, i.e., by the use of a thermal insulating barrier on the interior surfaces of the combustion space. The development and testing of ceramic coatings for diesel engine components are discussed. These coatings include oxides of Al, Cr, Zr, Mg, Si, Ti, and Ca, and Mo and Ch carbides. Data on their application and thermodynamic and wear characteristics are presented. It was concluded that, although the spraying processes used have not been optimized, plasma-spray technology has made it possible to coat diesel engine parts with ceramic materials. Preliminary results show that, relative to valves and piston crowns: stabilized ZrO_2 coating under certain conditions increases the working life of various components; higher combustion temperature may improve the thermal efficiency by increased turbocharger air delivery; reduction in the component temperatures decreases the thermal stresses; the ZrO_2.MgO shows improved corrosion resistance in combustion gases compared to ZrO_2.Y_2O_3 and ZrO_2.CaO; the limitations of the coatings have to be defined in more detail; and the adherence of thicker coatings has to be improved. Optimization of the spraying process with respect to particle fusion is necessary. Also, Mo and Ch carbide coatings were found to increase the service life of piston rings. (LCL)

29274 (EUR—6711-DE) **Reduction of fuel consumption by thermodynamic optimization of the Otto motor (comparative investigation of Otto diesel engines).** Gruden, D.; Hahn, R.; Loercher, H. (Porsche (F.) A.G., Stuttgart (Germany, F.R.)). 1980. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01.

Based on the example of a 2 l Otto-engine for the Porsche 924, it was demonstrated that by optimizing the compression ratio, combustion chamber shape, fuel-air ratio and ignition timing, it is possible to reduce the fuel consumption over the entire load and speed range from 4 to 30% in comparison with the conventional variant, without losing maximum power output. The thermodynamically optimized Otto-engine achieves the consumption values of diesel engines of similar displacement under stationary conditions. The compression ratio of the new engine is 13.0, and is operated with lean fuel/air-mixture ($\lambda \approx 1.2$) in the part load range. Performance tests in the Porsche 924 car have shown substantially better results with the optimized Otto-engine. The acceleration time from 0 to 100 km/h is 9.7 s for the Otto variant, and 24.7 s for the diesel engine. The fuel consumption of both variants is about identical in mixed traffic conditions (city, road, highway). Exclusively in city driving (ECE-test) the diesel-engine has a 9% better fuel consumption than the Otto-engine due to its lower idle fuel consumption. At higher speeds (90 and 120 km/h) the fuel consumption of the thermodynamically optimized Otto-engine is 2 to 8% lower.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 29162

29275 (UCRL—83824) **Analysis of aluminum-air battery propulsion systems for passenger vehicles.** Salisbury, J.D.; Behrin, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1980. Contract W-7405-ENG-48. 10p. (CONF-800806—15). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

The performance characteristics of three electric-propulsion systems based on the Al-air battery were analyzed and compared to the internal combustion engine (ICE). Battery characteristics projected from late 1979 and early 1980 experimental results were used in the analysis. In this comparison, the engine and fuel systems of a current five-passenger vehicle were conceptually replaced by three Al-air systems: (1) an Al-air battery-only system; (2) an Al-air battery combined with a nickel-zinc secondary battery for power leveling; and (3) an Al-air battery combined with a flywheel power leveler. The resultant vehicles were constrained to have range and acceleration performance equivalent to the ICE-powered vehicle. Performance characteristics such as the average consumption rate of Al metal for the selected drive cycle, vehicle mass, and power system mass were determined for each Al-air propulsion system. Estimates of initial-vehicle and life-cycle costs of Al-air battery-only vehicles indicate that all three systems can achieve performance and operation costs comparable to an ICE vehicle, and that the initial cost of Al-air battery-only vehicles can approach the cost of ICE vehicles but at reduced power levels.

29276 (UCRL—84443) **Aluminum air battery for electric vehicle propulsion.** Cooper, J.F.; Homsy, R.V.; Landrum, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 10p. (CONF-800806—19). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

The status of aluminum-air battery development and the use of aluminum as a recyclable electrochemical fuel are discussed. The battery combines high specific energy (above 300 Wh/kg) and specific power (150 to 200 W/kg) with the capability of rapid refueling by addition of reactants. The objective is a commercially-feasible, general-purpose electric vehicle. Progress is reported in the scale-up of aluminum-air single cells to the automotive scale (0.1 m^2-anodes) and in the development of a hydrargillite crystallizer, which is required to control electrolyte composition. Major technical problems and development strategy are discussed. The total cost and energy required to produce aluminum, and projected consumption by electric vehicles indicates that the aluminum-air powered electric vehicle is potentially competitive with advanced automobiles using synthetic liquid fuels.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 29272

MATERIALS

MATERIALS

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 28262, 28272, 28303, 28304, 28307

29277 (DOE/ER/01198—1309) **Report of the Panel on New Materials for the Council on Materials Science, United States Department of Energy.** (Stanford Univ., CA (USA). Center for Materials Research). Nov 1979. Contract AC02-76ER01198. 141p. NTIS, PC A07/MF A01.

Research is summarized concerning inorganic synthesis, new polymeric materials, intermetallic compounds, amorphous solids, thin films, solid state ionics, catalysis, and semiconductors. (FS)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 29309, 29310, 29326

29278 Method of fabricating thin-walled articles of tungsten-nickel-iron alloy. Hovis, V.M. Jr.; Northcutt, W.G. Jr. US Patent Application 076,528. [nd]. 12p.

The present invention relates to a method for fabricating thin-walled high-density structures of tungsten-nickel-iron alloys. A powdered blend of the selected alloy constituents is plasma sprayed onto a mandrel having the desired article configuration. The sprayed deposit is removed from the mandrel and subjected to liquid phase sintering to provide the alloyed structure. The formation of the thin-walled structure by plasma spraying significantly reduces shrinkage, and cracking while increasing physical properties of the structure over that obtainable by employing previously known powder metallurgical procedures.

29279 (CONS—3205-T1) **Development of a low loss magnetic composite utilizing amorphous metal flake. First semi-annual progress report, 19 September 1978-18 March 1979.** Johnson, L.A. (General Electric Co., Schenectady, NY (USA). Metallurgy Lab.). Apr 1979. Contract ET-78-C-01-3205. 68p. NTIS, PC A04/MF A01.

Progress is reported concerning processing amorphous metal flake by splat cooling and melt extraction, magnetic and physical properties assessment, and forming a composite of the metal flake and epoxy binders. (FS)

29280 (GEPP-TIS—494) **Molybdeum etching rate studies.** Spears, R.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 22 May 1980. Contract EY-76-C-04-0656. 13p. NTIS, PC A02/MF A01.

The etching characteristics of vacuum tube molybdenum inner sleeves and frames were determined for both dilute and strong acid. For the diluted acid, a linear relationship between percent weight removed and time was established, whereas, for the strong acid, a quadratic relationship was established. The inner sleeve, fabricated from arc cast molybdenum, etched faster than the frame that was hydroformed from powder metallurgical processed molybdenum sheets. Based on these studies, an etch time of 15 seconds with the diluted etchant was selected as an optimum time. This time period allowed sufficient etching without causing a fibrous surface structure on the inner sleeve.

29281 Analytical electron microscopy study of the high temperature carbide formed in a V-5 Ti-C alloy. Bruemmer, S.M. (Battelle-Northwest Labs., Richland, WA); Fluhr, C.P.; Beggs, D.V.; Wert, C.A.; Fraser, H.L. Contract EY-76-C-02-1198. *Metall. Trans., A;* **11**: No. 5, 693-699(May 1980).

A finely dispersed high temperature carbide that precipitates at 1000°C in a V-5 pct Ti-C alloy has been studied using analytical electron microscopy. The crystal structure has been determined using electron diffraction as B1 (NaCl-type) with a lattice parameter of 4.29A. The carbide develops a habit plane parallel to (001) of the matrix. The orientation relationship between the carbide and the matrix is (010) carbide parallel to (010) matrix, (001) carbide parallel to (101) matrix. The elemental concentrations of the metal constituents of the carbide have been deduced using energy dispersive x-ray spectroscopy and electron energy loss spectroscopy, through examination of core electron excitations. The composition of the carbide is found to be $V_{11}Ti_{39}C_{50}$, assuming a stoichiometric carbide.

29282 Electrowinning of gadolinium metal below 1000°C. An introductory investigation. Bratland, D.; Gschneidner, K.A. Jr. (Ames Lab., IA (USA)). *Electrochim. Acta;* **25**: No. 2, 145-149(Feb 1980).

Gadolinium was recovered as dendrites by electrolysis of Gd_2O_3 dissolved in molten LiF-GdF_3 (65 to 35 mol%) at 850 to 900°C. Both inert anodes (noble metals) and graphite anode were used. With a platinum anode, anodic corrosion began at current densities (cd) of about 9 A dm^{-2}. Below this cd the platinum appears to be passivated, and no platinum was detected in the electrowon gadolinium. Electrolysis with graphite anode resulted in carbon contamination of about 0.14 wt% of the gadolinium metal. The electrowon metal contained 100 to 500 wt ppm oxygen, depending on the oxide concentration in the electrolyte.

29283 Rolling of Be, W and V foil. Karasek, F.J. (Micro Foils, Argonne, IL (USA)). *Nucl. Instrum. Methods;* **167**: No. 1, 165-166(Dec 1979).

From 7. annual meeting of the International Nuclear Target Development Society; Garching, Germany, F.R. (11 - 14 Sep 1978).

Procedures are outlined for the fabrication of Be, W and V foils. Jacketing and rolling procedures are described in detail, as are the problems encountered during the processing. A discussion of the effect of various parameters on the fabrication of the foils is also presented.

29284 Bridging the gap betweeen dissimilar materials. Goodwin, G.M.; King, J.F. (Oak Ridge National Lab., TN). *Weld. Des. Fabr.;* v(May 1979).

When two sides of a joint have different properties, a compromise material should be used between them to accomodate differences in thermal expansion or diffusion effects. (FS)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 28978, 29281, 29309, 29319, 29329, 29850, 29851

29285 (DOE/ER/01198—1307) **Panel report on theory of surfaces.** (Illinois Univ., Urbana (USA). Materials Research Lab.). Jan 1979. Contract AC02-76ER01198. 72p. NTIS, PC A04/MF A01.

A report on the surface science workshop is given. Problem areas focussing on atoms, electrons, and alloys are described and the role of theory is discussed. (FS)

29286 (DOE/ER/05002—8) **High angle grain boundaries as sources or sinks for point defects.** Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Sep 1979. Contract AS02-78ER05002. 64p. (CONF-7909100—2). NTIS, PC A04/MF A01.

From American Society of Metals seminar; Milwaukee, WI, USA (15 Sep 1979).

A secondary grain boundary dislocation climb model for high angle grain boundaries as sources/sinks for point defects is described in the light of recent advances in our knowledge of grain boundary structure. Experimental results are reviewed and are then compared with the expected behavior of the proposed model. Reasonably good consistency is found at the level of our present understanding of the subject. However, several gaps in our present knowledge still exist, and these are identified and discussed briefly.

29287 (DOE/ER/05002—9) **Structure of high angle grain boundaries in metals and ceramic oxides.** Balluffi, R.W.; Bristowe, P.D.; Sun, C.P. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Dec 1979. Contract AS02-78ER05002. 70p. (CONF-791045—8). NTIS, PC A04/MF A01.

From American Ceramic Society conference; New Orleans, LA, USA (14 Oct 1979).

A critical review is given of the state of our current knowledge of the structure of high angle grain boundaries in metals and in ceramic oxides. Particular attention is given to effects due to differences in the bonding and crystal structure in these solid types. The results of recent experimental work and efforts to model grain boundary structure using computer simulation methods are described. Important characteristic features of boundaries in these materials are discussed. Difficulties which are presently being encountered in efforts to determine their structure are pointed out.

29288 (LBL—10683) **Detection of solute segregation at grain boundaries.** Briceno-Valero, J.; Gronsky, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 3p. (CONF-800801—7). NTIS, PC A02/MF A01.

From Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference; San Francisco, CA, USA (4 Aug 1980).

Studies of grain boundary segregation in metallurgical systems are traditionally based upon the premise that grain boundaries are more likely sites for solute atoms than their surrounding grains. This idea is manifested in experimental studies which distinguish the solute concentration at boundaries from that of grain interiors using various spectroscopic techniques, including more recently, energy dispersive x-ray analysis in TEM/STEM instruments. A typical study consists of spot or line scans across a grain boundary plane in order to detect concentration gradients at the boundary region. It has also been pointed out that there are rather severe problems in quantitatively determining the absolute solute concentration within the grain boundary, and data correction schemes for this situation have been proposed. The present paper is concerned with an alternative study of grain boundary segregation where the distribution of solute atoms along the boundary plane (as opposed to that across the boundary plane) is sought. The interest here is to establish whether or not a relationship exists between the structural defect configuration of the boundary plane and site preference for solute segregation.

29289 (LBL—10808) **Identification of some crystallographic features of martensite in steels by microdiffraction.** Sarikaya, M.; Rao, B.V.N.; Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 5p. (CONF-800801—4). NTIS, PC A02/MF A01.

From Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference; San Francisco, CA, USA (4 Aug 1980).

Considerable attention should be paid to the interpretation of electron diffraction, such as the understanding of the extra reflections and other effects in an SAD pattern obtained from lath martensite by making allowances for spatial resolution limitations in the SAD patterns. These difficulties can be overcome by utilizing the convergent beam electron diffraction (CBED) method which permits the use of different probe sizes to obtain crystallographic information from very small regions. Some crystallographic features of lath martensite in low and medium C steels have been identified and some others verified by using CBED.

29290 Sublimation thermodynamics of the URu_3 compound. Edwards, J.G.; Starzynski, J.S.; Peterson, D.E. (Department of Chemistry, University of Toledo, Toledo, Ohio 43606). *J. Chem. Phys.;* **73**: No. 2, 908-912(15 Jul 1980).

The sublimation behavior of the URu_3 intermetallic compound has been studied with a mass spectrometer—target collection apparatus. The sublimation reaction proceeded by dissociation to the elements up to the solidus temperature of the condensed phase. Vapor pressures of gaseous ^{233}U effusing from the Knudsen cell over the temperature range 1690—2100 K were measured by target collection and radioanalysis of the targets. A second-law treatment of the data yielded ΔH° (1896 K) and ΔS° (1896 K) of sublimation of 563.4 +- 13.4 kJ $mole^{-1}$ (134.6 +- 3.2 kcal $mole^{-1}$) and 147.8 +- 7.1 JK^{-1} $mole^{-1}$ (35.3 +- 1.7 cal K^{-1} $mole^{-1}$), respectively. The corresponding ΔH° (1896 K) and ΔS° (1896 K) of formation were -79.5 +- 20.9 kJ $mole^{-1}$ (-19.0 +- 5.0 kcal $mole^{-1}$) and -35.2 +- 10.5 JK^{-1} $mole^{-1}$ (-8.4 +- 2.5 cal K^{-1} $mole^{-1}$), respectively. Third-law treatment with estimated free energy functions yielded ΔH° (298 K) of sublimation and ΔH° (298 K) of formation of 572.2 +- 8.0 kJ $mole^{-1}$ (136.8 +- 1.9 kcal $mole^{-1}$) and -49 +- 22 kJ $mole^{-1}$ (-12 +- 5 kcal $mole^{-1}$),respectively.

29291 Theoretical analysis of thermal and mass transporting during laser annealing. Wood, R.F.; Giles, G.E.; Kirkpatrick, J.R. (Oak Ridge National Lab., TN). *SPIE Semin. Proc.;* **198**: 2-10(1980).

The radiation from high-power, Q-switched lasers has been recently in semiconductor research to (1) anneal the lattice damage caused by ion implantation, (2) diffuse surface-deposited dopant films, (3) recrystallize doped amorphous films deposited on substrates, and (4) remove precipitates present after conventional high-temperature, long-time, dopant diffusion. All of these phenomena can be understood in terms of a model based on macroscopic diffusion equations for heat and mass transport, cast in a finite-difference form to allow for the temperature- and spatial-dependence of the thermal conductivity, absorption coefficient of the laser radiation, and other quantities. Results of calculations with the model show that the near-surface region of the sample melts and stays molten for a time of the order of 10^{-7} secs during which dopant diffusion in the liquid state can explain the major features of the experimental results. Detailed results for arsenic-implanted silicon show the importance of non-equilibrium segregation effects.

29292 Heavy-ion track structure in silicon. Hamm, R.N.; Turner, J.E.; Wright, H.A.; Ritchie, R.H. (Oak Ridge National Lab., TN). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 6, 4892-4895(Dec 1979).

The energy deposition in the vicinity of a heavy ion path in silicon has been investigated by a Monte Carlo transport analysis of the delta rays produced along the track. The dose as a function of radial distance is presented for C, Al, and Fe ions with energies between 10 and 10,000 MeV. The average dose in cylinders of radii between 10^{-3} and 1 μm as a function of the distance of the cylinder from the path is also presented.

29293 Precipitation of carbon in nickel and nickel-titanium alloys. Bradley, D.J.(Oak Ridge National Lab., TN); Leitnaker, J.M.; Horne, F.H. *High Temp. Sci.;* **11**: No. 3, 137-151(Sep 1979).

Carbon in solution in nickel and nickel-3 at. % titanium alloy at 1100 to 1200°C can be recovered, nearly quantitatively as carbon, by quenching and electrolytic extraction from the matrix. This result leads to the conclusion that carbon agglomerates either on quenching or during the electrolytic process. Neither explanation appears wholly satisfactory. The result illustrates a pitfall in the analysis of microphases in metal alloys.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 28291, 28650, 28949, 28963, 28965, 28991, 29322, 29326, 29330, 29331, 30008, 30020

29294 (COO—4246-12/13) **Microstructural effects in abrasive wear. Quarterly progress report, January 1-June 1, 1980.** Fiore, N.F.; Kosel, T.H.; Channagiri, M.; Desai, V.; Fulcher, J.; Shetty, H.R. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). 1 Jun 1980. Contract AS02-77ET10460. 32p. NTIS, PC A03/MF A01.

Research aimed at establishing quantitative relationships between microstructure and wear resistance of highly alloyed materials is described including high-Cr white irons and experimental Co-base and Ni-base powder metallurgy (PM) alloys now used or potentially to be used in coal mining, handling and gasification. The specific types of wear under study are low-stress abrasion and gouging wear encountered in mining, coal conversion and transfer applications. Research has concentrated on the investigation of wear in Co-base PM alloys No. 19 and No. 6, which have been sintered to provide different carbide sizes at the same volume fraction in each respective alloy. Low-stress abrasion tests using Al_2O_3 abrasive have been completed on Alloy No. 19 and the results show a monotonic decrease in wear rate with increasing size. A series of single-point scratch test simulations of abrasive wear mechanisms has been initiated, and these tests provide valuable insights into material removal processes in the Co-base alloys.

29295 (DOE/ER/02166—26) **Study of grain boundary segregation using the Auger electron emission technique. Annual Technical Progress Report January 1, 1979-December 31, 1979.** Stein, D.F.; Heldt, L.A.; Funkenbusch, A.W. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1980. Contract AS02-76ER02166. 20p. NTIS, PC A02/MF A01.

The influence of grain boundary chemical composition on hydrogen embrittlement was investigated. Auger electron spectroscopy was employed to determine the grain boundary compositions of nickel-copper alloys containing various concentrations of phosphorus and subjected to various thermal treatments. Phosphorus segregates to grain boundaries during slow cooling, accompanied by reduced concentrations of grain boundary copper. Tensile tests were conducted in air and following cathodic charging with hydrogen. All samples tested in air exhibited a completely ductile fracture; ductility was insensitive to grain boundary composition. Fractures of hydrogen-charged samples were brittle and intergranular; elongation to fracture increased significantly with increasing concentration of grain boundary phosphorus. The influence of phosphorus segregation on embrittlement by hydrogen or by mercury (reported previously) is analyzed in terms of additive and interactive mechanisms. A mechanism based on reduced embrittler concentration at the site of bond rupture due to improved atomic packing is proposed and found to be consistent with the experimental results of this and other investigations.

29296 (DOE/ER/10556—1) **Combined macroscopic and microscopic approach to the fracture of metals. Technical annual progress report, 1979-1980.** Asaro, R.J.; Gurland, J.; Needleman, A.; Rice, J.R. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jun 1980. Contract AC02-80ER10556. 55p. (COO—3084-79). NTIS, PC A04/MF A01.

The following results are reported: (1) extremely good theoretical-experimental correlation was found between our theoretical predictions based on asymptotic analysis with numerical finite element studies and the experimentally monitored crack growth for a large range of stable crack growth in 4140 steel; (2) a theoretical model was developed for the critical conditions of crack initiation at rigid particles as a precursor of ductile rupture in steels; (3) as part of environmentally sensitive fracture mechanisms, it was found that hydrogen can promote a ductile-to-brittle fracture transition with increasing charging current density in low carbon steel; and (4) a new variational principle has been established for the combined processes of plastic creep flow and grain boundary diffusion and has been constructively applied to the problem of cavity growth under creep conditions.

29297 (HEDL-SA—1927) **In-reactor fatigue crack propagation.** Ermi, A.M.; Mervyn, D.A.; Straalsund, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 15p. (CONF-791102—158). NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Portions of document are illegible.

An in-reactor fatigue experiment is being designed to determine the effect of dynamic irradiation on the fatigue crack propagation (FCP) behavior of candidate fusion first wall materials. This investigation has been prompted by studies which show gross differences in crack growth characteristics of creep rupture specimens testing by postirradiation versus dynamic in-reactor methods. The experiment utilizes miniature center-cracked-tension specimens developed specifically for in-reactor studies. In the test, a chain of eight specimens, precracked to various initial crack lengths, is stressed during irradiation to determine crack growth rate as a function of stress intensity. Load levels were chosen which result in small crack growth rates encompassing a regime of the crack growth curve not previously investigated during irradiation studies of FCP. The test will be conducted on 20% cold worked 316 stainless steel at a temperature of 425°C, in a sodium environment, and at a frequency of 1 cycle/min. Irradiation will occur in the Oak Ridge Research Reactor, resulting in a He/dpa ratio similar to that expected at the first wall in a fusion reactor. Detailed design of the experiment is presented, along with crack growth data obtained from prototypic testing of the experimental apparatus. These results are compared to

data obtained under similar conditions generated by conventional test methods.

29298 (UCID—18729) **Experimental program to study the mechanical properties of beryllium. A status report.** Steinberg, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1980. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01.

Mechanical properties of Be were studied by launching flyers by a gas gun to strike a Be target backed by a LiF window. The motion of the Be-LiF interface was monitored. The effect of the yield strength of the LiF was negligible. (FS)

29299 (UCRL—84040) **Mechanical properties of high-current multifilamentary Nb_3Sn conductors.** Scanlan, R.M.; Hoard, R.W.; Cornish, D.N.; Zbasnik, J.P. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 23 May 1980. Contract W-7405-ENG-48. 13p. (CONF-800587—1). NTIS, PC A02/MF A01.

From International cryogenic materials conference; Upton, NY, USA (28 May 1980).

Nb_3Sn is a strain-sensitive superconductor which exhibits large changes in properties for strains of less than 1 percent. The critical current density at 12 T undergoes a reversible degradation of a factor of two for compressive strains of about 1 percent and undergoes an irreversible degradation for tensile strains on the Nb_3Sn greater than 0.2 percent. Consequently, the successful application of Nb_3Sn in large high-field magnets requires a complete understanding of the mechanical properties of the conductor. One conductor which is being used for many applications consists of filaments of Nb_3Sn in a bronze matrix, and much progress has been made in understanding the mechanical behavior of this composite. The Nb_3Sn filaments are placed in compression due to the differential thermal contraction between Nb_3Sn and bronze which occurs when the composite is cooled from the Nb_3Sn formation temperature (typically 700°C) to the 4.2°K operating temperature. The general behavior of the critical current when this conductor is subjected to a tensile stress is an increase to a maximum when the compressive strain on the Nb_3Sn is relieved, followed by a decrease as the Nb_3Sn filemants are placed in tension. The degree of precompression is controlled largely by the ratio of bronze to Nb_3Sn in the conductor.

29300 **Law of mixtures in dual-phase steels.** Koo, J.Y. (Rutgers Univ., Piscataway, NJ); Young, M.J.; Thomas, G. *Metall. Trans., A;* **11**: No. 5, 852-854(May 1980).

The applicability of the equation of the stress in the ferrite at the ultimate tensile strain to dual-phase steels obtained by heating 1010 and 1020 grades was tested. The law of mixtures describe the tensile strength of 1010 steels provided the dislocation hardening is included. The equation application to other dual phase systems may require modification to account for differences in metallurgical parameters. (FS)

29301 **Comparison of the dimple spacing on intergranular creep fracture surfaces with the slip band spacing for copper.** Nieh, T.G.; Nix, W.D. (Stanford Univ., CA). *Scr. Metall.;* **14**: No. 3, 365-368(Mar 1980).

The dimple spacing on intergranular fracture surfaces of copper were studied. A comparison of the dimple spacing with the slip band spacing indicates that the two quantities are the same within experimental error suggesting that cavities might be nucleated by a process involving the intersection of slip bands with grain boundaries. (FS)

29302 **Heavy Section Steel Technology (HSST) program.** Canonico, D.A. *Met. Prog.;* 1-10(Jul 1979).

The history of HSST program and the progress made in the program are discussed. Areas covered by the program are material characterization, fracture mechanics, fatigue, crack growth, pressure vessel tests, irradiation effects, and thermal shock. (FS)

29303 **Elastic-plastic R-curve description of fracture in Zr-2.5Nb pressure tube alloy.** Simpson, L.A.; Clarke, C.F. (Atomic Enery of Canada Ltd., Pinawa, Manitoba). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* 643-662(1979).

An R-curve approach was investigated with the aim of establishing a means of predicting critical crack lengths in Zr-2.5Nb pressure tubes using small fracture-mechanics specimens. Because of the elastic-plastic nature of the fracture process and limitations on the maximum specimen size, conventional R-curve methods were not applicable. The crack growth resistance was therefore expressed in terms of the crack opening displacement (COD) and R-curves were plotted for several sizes of specimens and crack lengths as 20°C and at 300°C. The effect of hydrogen on R-curve behavior at these two temperatures was investigated as well. Conventional clip-gage methods were not suitable for this work. Crack length was determined from electrical resistance, and COD, at the actual crack front, was determined from photographs of the specimens taken during testing. Crack length and specimen size had little, if any, effect on the R-curve shape. A method for expressing crack growth resistance in terms of the J-integral was also investigated and appears to be consistent with the COD approach. The effects of hydrogen and temperature on R-curve shape are cnsistent with their known effects on the mechanical behavior of Zr-2.5Nb. Finally, predictions of critical crack length in pressure tubes obtained by matching R-curves to crack driving force curves are consistent with published burst-testing data.

29304 **In-reactor defomation and fracture of austenitic stainless steels.** Bloom, E.E. (Oak Ridge National Lab., TN); Wolfer, W.G. Contract W-7405-ENG-26. *Am. Soc. Test. Mater., Spec. Tech. Publ.;* 656-672(1979).

An experimental technique for determining in-reactor fracture strain was developed and demonstrated. Differential swelling between a specimen holder and a test specimen with a lower swelling rate produced uniaxial deformation in 304 and cold-worked 316 stainless steel specimens. In-reactor deformations of 0.7 to 2.1% were achieved in Type 304 stainless steel previously irradiated to fluences up to 8.8×10^{26} neutrons (n)/m^2 without fracture. These strains are significantly higher than found in postirradiation creep-rupture tests on similar specimens. From the measured strain values and published irradiation creep data and correlations, the stress levels during the irradiation were calculated. On the basis of previous postirradiation creep-rupture results, many of the specimens that did not fail would be predicted to fail. Thus we conclude that the in-reactor rupture life is longer than predicted by post-irradiation tests. Strain in a fractured specimen was estimated to be less than 3.8%, and in the in-reactor fractures were intergranular - the same fracture mode as found in postirradiation tests. Irradiation creep may relax stresses at crack tips and sliding boundaries, thus retarding the initiation or growth of cracks, or both, and leading to longer rupture lives in-reactor. However, the very high ductility or superplastic behavior predicted by the strain-rate sensitivity or irradiation creep is not achieved because of the eventual interruption of the deformation process by grain boundary fracture.

29305 **New observations on the mechanisms of dynamic strian aging and of jerky flow.** Mulford, R.A.; Kocks, U.F. (Argonne National Lab., IL). *Acta Metall.;* **27**: 1125-1134(1979).

The rate sensitivity of the flow stress was investigated as a function of pre-strain for a commercial nickel alloy (INCONEL 600) and for polycrystalline Al-1% Mg, over a wide temperature range encompassing the regime of jerky flow. Anomalies were observed which suggest that the dynamic strain aging mechanism operates over a wider temperature range than that in which jerky flow is found. A detailed analysis shows that a negative rate sensitivity is associated with the strain hardening contribution to the flow stress from the beginning of deformation. The total rate sensitivity becomes negative only after this strain hardening contribution dominates. This suggests an interpretation of the critical strain for the appearance of jerky flow, which does not rely on the production of vacancies and moreover casts doubt on any interpretation that associates dynamic strain aging with the interaction of mobile solutes with the moving dislocations. Instead, a dislocation arrest model is used in which solute atoms diffuse along dislocations at forest intersections.

29306 **Influence of hydrogen on the behaviour of zirconium alloys in CANDU reactors.** Ells, C.E. (Chalk River Nuclear Laboratories, Ontario). *CIM Bull.;* 1-13(1978).

To exploit the advantages of natural uranium fuel, the cores of CANDU reactors are constructed from the neutron-economic zirconium alloys. In these alloys, hydrogen in excess of the solubility limit is precipitated as zirconium hydride. The hydride is a brittle material, and in some circumstances reduces the ductility of the zirconium alloy over a wide range of strain rates. All of the alloys contain hydrides when the reactor is at ambient temperature during shutdowns, and in varying degrees during reactor operation. To minimize the deleterious effect of the precipitated hydride, the components are fabricated and assembled so that the hydride platelets have the most innocuous possible orientation. The amount of deuterium pickup during operation is minimized by the selection of corrosion-resistant alloys. Cracking from hydrogen occurred in some Pickering pressure tubes, but the cause of this failure has been remedied and the failures were noteworthy only against the background of uniformly good behaviour of all core components.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 29279, 29285, 29853, 29854

29307 (BNL—27964) **Flux pinning in bronze-processed Nb_3Sn wires.** Suenaga, M.; Welch, D.O. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 13p. (CONF-800587—4). NTIS, PC A02/MF A01.

From International cryogenic materials conference; Upton, NY, USA (28 May 1980).

The scaling law derived by Kramer for magnetic flux pinning in high magnetic fields was examined for its applicability to the magnetic field dependence of critical-current densities in the bronze processed monofilamentary Nb_3Sn wires. From this it was concluded that: (1) its prediction for the form of the dependence of critical current on magnetic field and grain size [/J vector /sub c/ x H vector/ ~ h/sup 1/2/(1-h)^2(1-a_0√rho)$^{-2}$] was found to be very good in most cases including wires with very small Nb_3Sn grains (~ 400 A). It was found very useful in comparison of J/sub c/ for different wires and in extrapoiating to obtain H/sub c2/ for these wires. (2) However, it could not account consistently for the anisotropy in critical current of a tape which was measured with H applied perpendicular and parallel to the tape face. (3) The values of κ_1 which were determined with the scaling law were too small by a factor of 2 to 3, and the trend in the variation with heat-treating time was opposite to that which is reasonably to be expected. That the behavior of κ_1 is thus seriously in contradiction with the expected behavior for Nb_3Sn suggests basic faults in the derivation of the scaling equation for critical currents at high magnetic fields.

29308 (DOE/ER/01198—1314) **Thermodynamic properties of solid helium using an anharmonic anisotropic continuum model.** Berker, T.D. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract AC02-76ER01198. 106p. NTIS, PC A06/MF A01.

Thesis.

An anharmonic anisotropic continuum model is used to describe the thermodynamic properties of solid helium for all three structures (hcp, fcc, and bcc) and both isotopes. Using a 6-n potential with the de Boer value for the attractive parameter, the two repulsive parameters b/sub n/ and n are varied to obtain a best fit to experimental hcp ^{4}He data. The n = 11 potential gives good volume dependence over the entire experimentally accessible volume range, but too large an isotope effect. The n = 10 potential gives a better mass dependence, but a less satisfactory volume dependence. A detailed comparison of the calculations with experimental data shows that while it is possible to fit the volume dependence of the pressure, bulk modulus, and Debye temperature over a very wide range, the model overestimates the zero-point contribution to the free energy. The conclusion is reached that the major discrepancies obtained result from the failure of the continuum model to take account of dispersion. This failure can be remedied by artificially endowing the continuum with dispersion. A program for the further development of the model is outlined. It appears that the approach should be a practical one for realistic calculations of thermodynamic properties over wide volume ranges and useful for the estimation of interatomic potentials from solid state data.

29309 **Impurity stabilized A15 Nb_3Nb: a new superconductor.** Stewart, G.R.; Newkirk, L.R.; Valencia, F.A. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B: Condens. Matter;* **21**: No. 11, 5055-5064(1 Jun 1980).

We have succeeded in preparing by chemical vapor deposition essentially single-phase, A15 Nb_3Nb with the addition of small amounts of Ge or Si. The compositions and lattice parameters of the five samples reported on here are as follows: Nb_3(Nb/sub 0.92/Ge/sub 0.08/), 5.239 A; Nb_3(Nb/sub 0.82/Ge/sub 0.18/), 5.230 A; Nb_3(Nb/sub 0.71/Ge/sub 0.29/), 5.219 A; Nb_3(Nb/sub 0.61/Si/sub 0.39/), 5.213 A; Nb_3(Nb/sub 0.46/Si/sub 0.54/), 5.192 A. Using these compositions and lattice parameters, the lattice parameter for pure A15 Nb_3Nb is found to be 5.250 +- 0.005 A. The low-temperature specific heat of all five samples was measured from 1.4 to 11 K, showing bulk superconducting transitions in all cases, with T/sub c/ midpoint and ΔC/γT/sub c/ values as follows: Nb_3(Nb/sub 0.92/Ge/sub 0.08/), 5.2 K and 1.24; Nb_3(Nb/sub 0.82/Ge/sub 0.18/), 4.15 K and 1.16; Nb_3(Nb/sub 0.71/Ge/sub 0.29/), 3.6 K and 1.27; Nb_3(Nb/sub 0.61/Si/sub 0.39/), 5.4 K and 0.78; Nb_3(Nb/sub 0.46/Si/sub 0.54/), 3.4 K and 1.16. Transition widths were in general quite narrow, less than 0.5 K, and for Nb_3(Nb/sub 0.71/Ge/sub 0.29/), the transition width was 0.15 K. From the specific-heat measurements A15 Nb_3Nb has a T/sub c/ of ~ 6 K, a Θ/sub D/ of 270 +- 10 K, equivalent to that of bcc elemental Nb, and a density of states of 1.22 +- 0.1 states/eV atom. Microprobe analysis of the A15 Nb_3Nb samples shows no detectable oxygen, i.e., <0.2 at. %. In addition to the essentially single-phase samples, a predominantly A15 sample with a_0=5.246 A and 50% bcc Nb second phase has been prepared, with less than 3% of the B-site atoms occupied by Ge, showing that A15 Nb may be stabilized by less than 1% second-atom additions.

29310 **Diffusion of Al into Au thin films studied by the ATR method.** Loisel, B.; Arakawa, E.T. (Oak Ridge National Laboratory, Health & Safety Research Division, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Appl. Opt.;* **19**: No. 12, 1959-1962(15 Jun 1980).

Alloy formation in Au—Al thin films has been studied by the attenuated total reflection (ATR) method in the 64—80°C temperature range. In this optical method, the coupling of incoming light with a surface plasmon at the metal—dielectric interface appears as a sharp minimum in the reflectance spectrum of p-polarized light. The angular position of this minimum is very sensitive to the optical constants of the metal near the interface. This makes the method suitable for studies of diffusion in metals. In the presence of unreacted aluminum, the energy of activation for the growth of Au_2Al is found to equal 22.9 kcal/mole.

29311 **Neutron study of magnetic-moment distribution in Ni-Pt alloys.** Parra, R.E.; Cable, J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5494-5504(15 Jun 1980).

The average moments and the moment disturbances of ferromagnetic Ni-Pt alloys with concentrations of 20, 30, 40, 50, 55, and 57 at. % Pt have been measured by the magnetic diffuse scattering of neutrons. The data have been analyzed with the linear superposition model of Marshall including short-range order. The data have also been discussed in terms of Medina's chemical-magnetic environment model which assumes that the moment on an Ni atom is a function of the magnetic moments of the surrounding atoms and of its nearest chemical environment. The results show that the average Ni moment decreases with increasing Pt concentration, while Pt has an average moment of about half that of Ni. The moment disturbance functions, corrected for short-range order, show peaks in the forward direction corresponding to inhomogeneous-moment distributions which may be described as ferromagnetic clusters. The analysis of the data with the chemical-magnetic environment model shows that most of the moment disturbances are caused by the magnetic environment in accordance with other Ni-based alloys. An apparent difference in the macroscopic magnetization of these systems is attributed to differences in chemical short-range order rather than to a different mechanism for the onset of ferromagnetism.

29312 **Optical properties and electronic structure of β′-NiAl.** Peterman, D.J.; Rosei, R.; Lynch, D.W.; Moruzzi, V.L. (Ames Laboratory, U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5505-5510(15 Jun 1980).

The optical constants and their temperature derivatives have been determined for β′-NiAl from absorption and thermoreflectance measurements in the energy range of 0.2—4.4 eV. The results are interpreted using the self-consistent energy bands of Moruzzi, Williams, and Gelatt. By comparing a calculated joint density of states with ϵ_2, the imaginary part of the dielectric function, good overall agreement is found between theory and experiment. In contrast to earlier analyses, it is found that the 2.5-eV peak in ϵ_2 is primarily due to direct interband transitions terminating near the Fermi surface. This new interpretation of the 2.5-eV feature is discussed in relation to previously reported concentration effects and the rigid-band model.

29313 **Heat of solution of hydrogen in aluminum.** Kahn, L.M.; Perrot, F.; Rasolt, M. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5594-5600(15 Jun 1980).

The interaction of a proton with an aluminum host is treated within the spherical model of a solid. Our results give for the heat of solution and activation energy of H in Al 0.593 and 0.5 eV, respectively, compared with the experimental values of 0.66 and 0.52 eV. The previously untreated nonspherical corrections are also estimated and shown to be small.

29314 **Self-consistent electronic structure of surfaces: Surface states and surface resonances on W(001).** Posternak, M.; Krakauer, H.; Freeman, A.J.; Koelling, D.D. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5601-5612(15 Jun 1980).

Surface states (SS) and surface resonances (SR) on the W(001) surface have been determined from the first self-consistent energy-band study of this metal surface. The calculations were performed for a seven-layer film using our thin-film linearized augmented-plane-wave method which includes all relativistic corrections except the spin-orbit interaction. Self-consistency was found to be essential for obtaining an accurate value of the work function: 4.5 +- 0.2 eV, in excellent agreement with experiment. No evidence was found for surface core-level shifts as observed in photoemission from the (110) surface, indicating the possible importance of final-state effects. A complete description of all three experimentally observed resonance bands is given for the first time: SS and SR states are found to exist in different portions of the two-dimensional Brillouin zone; their location and symmetry are in very good agreement with structure observed in photoemission at 0.3, 0.8, and 4.2 eV below the Fermi energy E/sub F/. Particularly interesting is the close agreement of the never before obtained k/sub parallel/=0 true SS (at -0.3 eV) with experiment.

29315 **Dislocation stress-velocity dependence in alloys.** Schwarz, R.B. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5617-5627(15 Jun 1980).

The frictional stress σ(v) is calculated for a dislocation gliding at an average velocity v on a plane containing a fixed random distribution of weak obstacles of finite interaction range, in the presence of viscous forces. For very low viscous forces the dislocation travels quasistraight, overcoming each obstacle independently of the relative positions of the other ones. Dislocation glide is possible only for v> or ≈1/50v/sub s/, where v/sub s/ is the sound velocity in the solid. The frictional stress has the usual viscous drag component plus an extrinsic component proportional to the solute concentration, which vanishes asymptotically for v >> 1/50v/sub s/. For high viscous forces, glide is possible at all velocities for stresses above a critical stress σ/sub c/. For σ ≃ σ/sub c/ the motion is sensitive to the obstacle statistics. For σ> or ≈2σ/sub c/ the motion is mostly drag controlled, with characteristics similar to those observed in the presence of low viscous forces.

29316 Molecular Jahn-Teller resonance states as possible antecedents to magnetism in the Fe group. Abell, G.C. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). DE-AC04-DPO0053. *Phys. Rev. Lett.;* **44**: No. 19, 1264-1267(12 May 1980).

This article gives a microscopic description of magnetism in the Fe group, based on tetratomic spin-polarized Jahn-Teller resonance states. Ferromagnetism is due to Hund's-rule intra-atomic exchange coupling between molecular magnetic states having a common atom. Magnetic anisotropy is determined by the molecular symmetry axis of the resonance state.

29317 Tritium permeation through clean Incoloy 800 and Sanicro 31 alloys and through steam oxidized Incoloy 800. Bell, J.T. (Oak Ridge National Lab., TN); Redman, J.D.; Bittner, H.F. *Metall. Trans., A;* **11**: No. 5, 775-782(May 1980).

The tritium permeabilities, DK, of Incoloy 800 and Sanicro 31 have been determined for tube samples that were protected from surface oxidation by electroplated nickel. The permeabilities of these analogous alloys over the 400 to 750°C range were essentially equal; DK = 0.566 exp (-16120/RT) and 0.367 exp (-15610/RT cm³ (T_2.STP).mm/(cm².min.torr/sup 1/2/), respectively. The effects of in-situ steam oxidation of Incoloy 800 were observed to reduce tritium permeabilities by factors up to 400 at 150 days. Permeabilities of the oxides formed at 520, 660 and 725°C were determined to be 5.4 E-11, 4.9 E-10 and 2.4 E-9 cc (T_2, STP) .mm/(cm².min.torr/sup 1/2/), respectively. Severe thermal shock was observed to essentially destroy the permeation barrier characteristics of the oxide coatings while mild temperature cycling had no observable effects on permeation rates through the oxide coated material.

29318 Conditions for validity of the expression ΔS = -(∂T/∂ΔG)/sub t/. Pound, G.M.; Lothe, J.; Nix, W.D.; Barnett, D.M.; DiMelfi, R.J. (Stanford Univ., CA). *Scr. Metall.;* **14**: No. 3, 369-372(Mar 1980).

The validity of the relation ΔS = -(∂T/∂ΔG)/sub t/ for the entropy changes in solids was studied. It was found that the structure must be a point or state function of the variable Temperature T_1 and the tractions, t. (FS)

29319 Thermodynamic properties of potassium oxides. Byker, H.J. (Montana State Univ., Bozeman); Eliezer, I.; Howald, R.C.; Ehlert, T.C. *High Temp. Sci.;* **11**: No. 3, 153-170(Sep 1979).

$KO_{0.5}$ has been prepared by the reaction of excess potassium with KNO_3 in an effusion cell. Observations of the $2KO_{0.5} \rightarrow K_2O(g)$ equilibrium mass spectrometrically give a new value for the enthalpy of solid $KO_{0.5}$, ΔH/sub f,298/° = -170 +- 5 kJ mol⁻¹. Observations on KO^+ in the same series of experiments give good estimates for the thermodynamic properties of $K_2O_2(g)$. This leads to an improved interpretation of data on the vaporization of $KO_{0.5}$-K_2O_2 mixtures and solutions. Similarly literature data on the K_2O_2-KO_2 system have been collected and reexamined, leading to the values ΔH/sub f,298/° = -495.4 kJ mol⁻¹ and S_{298}° = 110.1 J mol⁻¹ K⁻¹ for K_2O_2(s). We have calculated a preliminary phase diagram for the entire region from $KO_{0.5}$ to KO_2, treating the liquid as solutions of O (l) in $KO_{0.5}$ (l). Differential thermal analysis data supporting the calculated phase diagram are reported.

29320 Determination of a Cu(110) surface contraction by leed intensity analysis. Davis, H.L.; Noonan, J.R.; Jenkins, L.H. (Oak Ridge National Lab., TN). *Surf. Sci.;* **83**: 559-571(1979).

Normal incidence LEED intensity spectra from six symmetrically inequivalent diffraction beams from a clean Cu(110) surface are presented and analyzed. The analysis has employed the results of two distinct sets of dynamical LEED calculations, which differ only in the choice of the electron scattering potential. It is indicated by the analysis that the Cu(110) surface region is in lateral registry with the truncated bulk, the first atomic layer is contracted toward the second by 10.0 +- 2.5% relative to the bulk spacing, and the second to third layer spacing is within 2.5% of the bulk value. A discrepancy of unknown origin has been found between the experimental and calculated I-V profiles for three beams in the 60 eV region; however, this discrepancy does not appear to affect the crystallographic conclusions of the analysis.

29321 Effect of aluminum additions on the thermodynamic and structural properties of LaNi/sub 5-x/Al/sub x/ hydrides. Mendelsohn, M.H.; Gruen, D.M.; Dwight, A.E. (Argonne National Lab., IL). *Adv. Chem. Ser.;* No. 173, 279-295(1979).

Desorption isotherms for the hydrides of $LaNi_{4.8}Al_{0.4}$ and $LaNi_{4.8}Al_{0.5}$ are presented and values for the enthalpy and entropy changes of the hydriding reactions are calculated from the van't Hoff plots of log P vs 1/T. A crystallographic model of $LaNi_4Al$ is shown and consideration of the nearest neighbor atom distribution leads to a rationalization of the observed linear relationship between the enthalpy change, ΔH, and the aluminum composition. Brief discussions of methods to predict dissociation pressures or interstitial site occupation are included. The cubic and hexagonal AB_5 phases are compared and, finally, the application of these alloys in chemical heat pump systems is noted.

29322 Hydrogen embrittlement effects in hydride-forming metals. Dutton, R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). *CIM Bull.;* 1-10(1978).

Metals which occlude hydrogen exothermically form hydrides above the solubility limit. These hydrides are generally brittle in nature and therefore cause structural embrittlement. This is manifest by gross loss of ductility during rapid straining and also time-delayed embrittlement during slow strain rate or static loading. The emphasis in this paper is on the latter. The effects of temperature and stress on hydride precipitation, and the consequent redistribution of hydrogen in a stress gradient, are discussed. It is shown how this leads to the accumulation of hydrides at the tip of a stressed crack, resulting in subsequent delayed fracture. This mechanism is discussed in terms of recent theoretical and experimental developments.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 28267, 28291, 28370, 28659, 28764, 28775, 28911, 28966, 28967, 28994, 29317

29323 Method for inhibiting corrosion of nickel-containing alloys. DeVan, J.H.; Selle, J.E. US Patent Application 074,288. [nd]. 14p.

Nickel-containing alloys are protected against corrosion by contacting the alloy with a molten alkali metal having dissolved therein aluminum, silicon or manganese to cause the formation of a corrosion-resistant intermetallic layer. Components can be protected by applying the coating after an apparatus is assembled.

29324 (BNL—27344) Application of analytical electron microscopy to the study of intergranular corrosion in 304 stainless steel. Pande, C.S.; Sabatini, R.L. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-800801—5). NTIS, PC A02/MF A01.

From Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference; San Francisco, CA, USA (4 Aug 1980).

The technique of analytical electron microscopy in a scanning transmission electron microscope fitted with an energy dispersive x-ray spectrometer is used to measure the chromium depletion in sensitized 304 stainless steel along the grain boundaries. It is shown that such measurements could be misleading unless care is taken to properly choose the regions on the grain boundaries for such analysis.

29325 (HEDL-SA—2150-FP) Characterization of the sodium corrosion behavior of commercial austenitic steels. Shiels, S.A.; Bagnall, C.; Keeton, A.R.; Witkowski, R.E.; Anantatmula, R.P. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.; Westinghouse Research and Development Center, Pittsburgh, PA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 8p. (CONF-800401—22). NTIS, PC A02/MF A01.

From 2. international conference of liquid metal technology for energy systems; Richland, WA, USA (20 Apr 1980).

During the course of an on-going evaluation of austenitic alloys for potential liquid metal fast breeder reactor (LMFBR) fuel pin cladding application, a series of commercial alloys was selected for study. The data obtained led to the recognition of an underlying pattern of behavior and enabled the prediction of surface chemistry changes. The changes in surface topographical development from alloy to alloy are shown and the important role played by the element molybdenum in this development is indicated. The presentation also illustrates how a total damage equation was evolved to encompass all aspects of weight loss and metal/sodium interactions: wall thinning ferrite layer formation and intergranular attack. The total damage equation represents a significant departure from the classical description of sodium corrosion in which weight loss is simply translated into wall thinning.

29326 (SAND—80-0132) **Effect of quench rate on the mechanical properties of U-6 wt % Nb.** Eckelmeyer, K.H. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

U-6 wt % Nb conventionally is water quenched from 800°C in order to obtain a niobium supersaturated α'' structure having good corrosion resistance and high ductility (125% tensile elongation). The high cooling rate associated with the water quench, however, produces undesirable distortion and residual stress. This study was conducted to determine the extent to which the quench rate could be reduced (in order to minimize the distortion and residual stress problems) without sacrificing properties. The results indicate that quench rate can be reduced by as much as a factor of 10 without any loss of ductility, and that a factor of 100 reduction in quench rate (as is produced by air cooling) still produces material with moderate ductility (> 12% tensile elongation). The results also indicate that supersaturated α'' structures are produced at all of these quench rates. This suggests that these reductions in quench rate should not have drastic adverse effects on corrosion resistance. Hence, it should not be possible to substantially reduce the magnitudes of the distortion and residual stress problems while retaining appreciable ductility and corrosion resistance in U-6 wt % Nb.

29327 **Oxidation of ordered Zr_3Al.** Schulson, E.M. (Dartmouth Coll., Hanover, NH); Trottier, T.P. *Metall. Trans., A;* **11**: No. 5, 727-738(May 1980).

Weight gain measurements have been made and metallographic examinations have been carried out on the oxidation of ordered Zr_3Al polycrystals in steam at 675 to 925°K and in pressurized water at 575°K. The study shows that the oxidation rate increases exponentially with increasing volume fraction, f/sub α/, of second-phase αZr particles; that a change occurs in the nature of oxidation at 825 to 875°K; that at 675 to 825°K oxidation is characterized by a breakaway to a higher oxidation rate; that weight gain and oxide film thickening kinetics in pressurized water obey quartic to cubic rate laws, at least for times up to 716 days; and that short-circuit mass transport occurs along dislocations and along grain boundaries. The study also shows that in pressurized water and in steam at temperatures <725°K, the oxidation resistance of Zr_3Al is greater than that of Zircaloy-2, provided that f/sub α/ < 0.03 +- 0.01. The results are interpreted in terms of the microstructure of the alloys and of the oxide films and in terms of the decomposition phase transformation $Zr_3Al \rightarrow Zr_3Al + Zr$.

29328 **Analysis of oxide coatings on steam-oxidized Incoloy 800.** Bittner, H.F. (Oak Ridge National Lab., TN); Bell, J.T.; Redman, J.D.; Christie, W.H.; Eby, R.E. *Metall. Trans., A;* **11**: No. 5, 783-790(May 1980).

In-situ formed oxide coatings have been proposed as hydrogen permeation barriers for candidate materials in heat exchangers and for hydrogen containment. In this regard oxides formed by oxidation of Incoloy 800 in 243 and 532 torr (1 torr=133.3 Pa) steam at 933°K, and in 714 torr steam at 793, 933, and 998°K for exposure times up to 5000 h, have been chemically analyzed. Analytical techniques included ion microprobe mass analysis and optical microscopy. Sample pretreatment, including electropolishing, annealing and cold working, affected the oxidation chemistry. Steam oxidation of electropolished samples formed thick iron oxide at the steam-oxide interface. Electropolished/annealed samples (1173°K for one h under vacuum) formed iron oxide at short exposure times, however longer exposure resulted in the iron oxide spalling, leaving a thin oxide rich in chromium and manganese. Subsequent cold work on annealed samples led to higher iron content in the oxide upon steam exposure.

29329 **Influence of carbon content and ferrite morphology on the sensitization of duplex stainless steel.** Devine, T.M. (General Electric Co., Schenectady, NY). *Metall. Trans., A;* **11**: No. 5, 791-800(May 1980).

The influence of ferrite morphology and carbon content on the intergranular corrosion behavior of 308 stainless steel was investigated using four wrought alloys and six weld deposited alloys. The four wrought alloys were heat treated at four different annealing temperatures to introduce four different amounts of ferrite. The annealed samples along with the weld deposited alloys were aged at temperatures ranging from 480 to 700°C for times varying between 15 min and 1000 h and then tested for intergranular corrosion susceptibility in acidified copper-copper sulfate solution. For a given carbon content there exists a critical amount and distributions of α-γ boundary area above which the alloy is immune and below which it is susceptible to intergranular corrosion. For amounts and distribution of α-γ boundary area less than the critical value two types of sensitization behavior are possible. First, there may be a sufficient amount and distribution of α-γ boundary area to insure rapid healing of the sensitized microstructure. Second, there may be an inadequate amount or distribution of α-γ boundary area to produce either immunity or rapid healing and the alloy behaves as a fully austenitic alloy regardless of the amount of ferrite present. A model is presented which describes as a function of carbon content the critical amounts and distributions of α-γ boundary area required for rapid healing and immunity to sensitization.

29330 **Propagation of transgranular stress-corrosion cracks in Admiralty Metal.** Beavers, J.A. (Battelle-Columbus Labs., OH); Pugh, E.N. Contract EY-76-C-02-1198. *Metall. Trans., A;* **11A**: No. 5, 809-820(May 1980).

An investigation has been made of the propagation of transgranular stress-corrosion cracks in monocrystals and polycrystals of Admiralty Metal tested in ammoniacal solutions. Studies were made of the topography and orientation of the fracture surfaces, the acoustic emission during crack propagation, and the stress dependence of the crack velocity. Cracking was found to occur on parallel but displaced (110) facets, and the steps between the fracture facets also were crystallographic in nature, consisting of alternating segments of two (111) planes. The overall direction of the steps was found to be perpendicular to the crack front, and examination of opposing fracture surfaces indicated that the surface features are matching and interlocking. While not generally resolvable with the SEM, crack-arrest markings could be detected on the fracture faces under certain conditions, and this, together with the occurrence of discrete acoustic-emission events, indicated that propagation is discontinuous. Based on these and other observations, it is suggested that propagation occurs by discontinuous cleavage on (110) planes and that the steps are produced by shear on (111) planes. Possible mechanisms of embrittlement are discussed.

29331 **Effect of cathodic potential on corrosion fatigue crack growth rates of a Ni-Cr-Mo-V turbine disc steel in room temperature caustic environment.** Rungta, R. (Battelle-Columbus Labs., OH); Begley, J.A. *Metall. Trans., A;* **11**: No. 5, 821-830(May 1980).

Corrosion fatigue crack growth rates were measured on compact toughness specimens of ASTM A-471 turbine disc steel in room temperature 12M NaOH solution. The role of cathodic potentials on corrosion fatigue crack growth rates was investigated. Intergranular cracking was observed at cathodic potentials compared to transgranular cracking at open circuit potential and in air. The results suggest a hydrogen embrittlement mechanism of cracking at cathodic potentials. The results suggest that hydrogen diffusion into the material ahead of the crack tip is not rate controlling but is a necessary condition to accelerated cracking. Positive and negative sawtooth wave form results show that environmental effects are accelerated during loading part of the cycle when deformation is occurring. The results have also been analyzed with respect to the linear superposition model proposed by Wei and Landes.

29332 **Corrosion and contaminant control concerns in central station steam supply systems.** Pocock, F.J. (Babcock & Wilcox Co., Alliance, OH). *J. Mater. Energy Syst.;* **1**: No. 2, 3-14(Sep 1979).

Modern Central Station Steam Supply Systems require high purity water and exacting control of the corrosion process for the many materials that are used in this environment. This paper discusses the impurity limits recommended by component suppliers for the feedwater, boiler water and steam to turbines. It also shows experimental results that establish proper cycle pH and discusses volatile additions used to accomplish pH and dissolved oxygen control. The unit process-condensate polishing-and its application for dissolved solids removal are also discussed along with other methods of corrosion product transport and component corrosion product accumulation control. Protection of equipment during storage periods is addressed as well as the physical chemistry of dissolved salt and copper transport in steam. Since perfect water treatment control with the various materials used is not practical, chemical cleaning as a method of removing the accumulations of corrosion products and other contaminants in major system components is also discussed.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 28975, 28988, 28990, 28992, 28993, 29073, 29302, 29304, 30008, 30011, 30018, 30019

29333 (CONF-800609—3) **Microstructure and tensile properties of heavily irradiated 5052-0 aluminum alloy.** Farrell, K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

During neutron irradiation of an aluminum 2.2% magnesium solid solution alloy in the High Flux Isotope Reactor to fast and thermal fluences > 10^{27} neutrons (n)m^2 at 328°K (0.35 T/sub m/) about seven percent insoluble, transmutant silicon was produced. Some of this silicon reacted with the dissolved magnesium to form a fine precipitate of Mg_2Si. A tight dislocation structure was also created. The alloy showed good resistance to cavity formation. Tension tests at 323, 373, and 423°K (0.35, 0.40, and 0.45 T/sub m/) showed pronounced irradiation-induced strengthening and an associated marked loss in ductility. These changes were greater than in

magnesium-free aluminum and in alloys containing preexisting, thermally-aged Mg_2Si precipitate. Increasing the thermal-to-fast flux ratio from 1.7 to 2.1 caused further strengthening beyond that expected from a simple increase in silicon level.

29334 (HEDL-SA—2003-FP) **Effect of temperature changes on swelling and creep of AISI 316.** Garner, F.A.; Gilbert, E.R.; Gelles, D.S.; Foster, J.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 22p. (CONF-800609—8). NTIS, PC A02/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

A number of previous publications have shown that the swelling of cold-worked AISI 316 is quite sensitive to changes in temperature which occur during irradiation. In this report those data are expanded and reanalyzed to show that the concurrent irradiation creep is also quite sensitive to changes in irradiation temperature. An explanation is advanced to explain this behavior in terms of the sensitivity to temperture history of the radiation-induced microchemical evolution of this steel. In particular, the sensitivity to temperature history of the radiation-stabilized gamma prime phase is invoked to explain the enhanced creep and swelling behavior of AISI 316 components which experienced either gradual or abrupt decreases in temperature. The phase development observed in this steel in response to temperature changes during irradiation is also compared to the similar behavior found in aged specimens subjected to isothermal irradiation.

29335 (SAND—80-0839C) **Radiation-hard silicon gate bulk CMOS cell family.** Gibbon, C.F.; Habing, D.H.; Flores, R.S. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 7p. (CONF-800703—2). NTIS, PC A02/MF A01.

From Annual conference on nuclear and space radiation effects; Ithaca, NY, USA (15 Jul 1980).

A radiation-hardened bulk silicon gate CMOS technology and a topologically simple, high-performance dual-port cell family utilizing this process have been demonstrated. Additional circuits, including a random logic circuit containing 4800 transistors on a 236 x 236 mil die, are presently being designed and processed. Finally, a joint design-process effort is underway to redesign the cell family in reduced design rules; this results in a factor of 2.5 cell size reduction and a factor of 3 decrease in chip interconnect area. Cell performance is correspondingly improved.

29336 **Self-diffusion in austenitic Fe-Cr-Ni alloys.** Rothman, S.J.; Nowicki, L.J.; Murch, G.E. (Argonne National Lab., IL (USA)). *J. Phys., F (London);* **10**: No. 3, 383-398(Mar 1980).

The simultaneous lattice diffusion of ^{59}Fe, ^{51}Cr and ^{57}Ni tracers has been measured in the alloys Fe-15Cr-20Ni, Fe-15Cr-45Ni, Fe-22Cr-45Ni and Fe-15Cr-20Ni-1.4Si between 960 and 1400°C. In all four alloys at all temperatures, Dsub(Cr) > Dsub(Fe) > Dsub(Ni), with Dsub(Cr)/Dsub(Ni) approximately = 2.5 and Dsub(Fe)/Dsub(Ni) approximately = 1.8. The activation enthalpies for diffusion of the major constituents in any one alloy are quite close to each other. No correlation is found between swelling under irradiation and the diffusion behaviour of the major constituents. The results are discussed on the basis of the random-alloy model. Grain-boundary diffusion is found in these alloys at surprisingly high temperatures.

29337 **Defect annealing studies in neutron transmutation doped silicon.** Larson, B.C.; Young, R.T.; Narayan, J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. pp 281-290 of Neutron transmutation doping in semiconductors. Meese, J.M. (ed.). New York, NY; Plenum Publishing Corporation (1979).

Electrical, optical, x-ray and electron microscopy techniques have been used to investigate lattice damage and annealing in NTD silicon. Dislocation loops of 10 to 100 A diameter were identified in both the as irradiated state and after thermal anneals of up to 900°C by the electron microscopy and x-ray techniques. A correlation of these results with the infrared absorption and electron mobility recovery stage between 600 and 750°C suggests that defects < 10 A are also contributing to the recovery processes at this temperature.

29338 **Yield point phenomena in mild steel - effect of neutron irradiation and nitrogen concentration.** Murty, K.L. (Westinghouse R and D Center, Pittsburgh, PA); Hall, E.O. *Trans. Am. Nucl. Soc.;* **33**: 283-284(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29339 **Validity of helium preinjection in radiation damage simulation.** Packan, N.H.; Farrell, K. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 290-291(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29340 **Helium cavitation and its relation to TiC precipitation in an alpha-irradiated stainless steel.** Kesternich, W. (Institut fuer Reaktorentwicklung der Kerforschungsanlage Juelich, Germany). *Trans. Am. Nucl. Soc.;* **33**: 291-293(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 28308, 29260, 29277

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 28801

29341 (LA-tr—80-18) **Method for reducing plutonium losses during preparation of uranium-plutonium mixed carbide.** Vollath, D. Jun 1980. Translation of . German(FRG) Patent 2,621,743. 12p. NTIS, PC A02/MF A01.

A mixture of uranium dioxide, plutonium dioxide, and graphite is subjected to a carbothermic reduction, characterized by the following method steps in the established order: (a) grinding a mixture of uranium dioxide, plutonium dioxide, and graphite for 1 to 3 hours; (b) heating the ground mixture from (a) to a temperature above 1600°K until the carbothermic reduction to mixed carbide seed formation sets in; (c) cooling the reacting mixture to a temperature in the region of 1300°K to 1550°K; (d) maintaining the temperature developing after cooling constant until abatement of the carbon monoxide evolution indicates complement of a first part step of the carbothermic reduction; and (e) reheating the reaction mixture to form a monophase, practically oxygen-free uranium-plutonium mixed carbide up to a temperature in the region of 1800°K after the ad interim abatement of CO evolution and hence, the successful completion of a second part step of the carbothermic reduction, and then cooling the end product.

29342 **Ceramic spring for high-temperature valves.** Harper, C.R. (Consolidated Controls Corp., El Segundo, CA). *J. Mater. Energy Syst.;* **1**: No. 2, 62-67(Sep 1979).

A ceramic seat preloading spring has been built for use in high-temperature coal gasification valves. The use of a ceramic material avoids many of the problems associated with coal conversion environments, which consist of hot, corrosive gases, mixed with abrasive solids of varying sizes. The design initially relied on conventional spring formulas, and was refined on the basis of testing. The resulting ceramic spring displays essentially linear load-deflection characteristics, and can be used at temperatures up to 900°C without taking a permanent deflection. The spring will be tested further in an 8 in. valve designed specifically for use on coal gasification plants.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 28969, 29287, 29415

29343 (GEPP-TIS—493) **Microstructure of gross chill-mark defect in a glass-ceramic preform.** Spears, R.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 21 May 1980. Contract EY-76-C-04-0656. 12p. NTIS, PC A02/MF A01.

The microstructure of a vacuum tube glass-ceramic preform containing gross chill-marks on the top and bottom surfaces as well as on the sides was analyzed. The preform was ceramed in a graphite mold and examined using SEM. The glass-ceramic had an extremely dense and fine crystalline structure except where the chill-marks were located. In those areas of matrix glass following the chill-mark plane were evident. It is concluded that gross chill-marks will affect the microstructure by disrupting the chemistry or nucleating characteristics in such a way that a chill-mark regon would appear to be depleted of crystallites. Although the crystallites in this region are larger, the quantity is lower than in the base glass-ceramic. The affected area caused by the chill-mark left a band of matrix glass approximately 100 μ wide. It is believed that planar defects of this size will degrade the mechanical and permeation properties of the glass-ceramic.

29344 **Effects of space charge, grain-boundary segregation, and mobility differences between grain boundary and bulk on the conductivity of polycrystalline Al_2O_3.** Tiku, S.K.; Kroeger, F.A. (Univ. of Southern California, Los Angeles). Contract EY-76-03-0113. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 183-189(Mar 1980).

The potential difference between grain boundary and bulk and the concentrations of native and foreign point defects in the bulk, the grain boundary (gb), and the subgrain boundary space-charge region (sg) of polycrystalline Al_2O_3 doped with acceptors are computed for the case that the dopants segregate at the grain boundaries, with either the ionized or the nonionized acceptor as the dominant species. Expressions are derived for the effective dc conductivity of a polycrystalline material on the basis of a model in

which the grain has one or two shells with conductivities different from that of the bulk. Combination of the two results yields expressions for the effective ionic and electronic conductivity of doped Al_2O_3 as a function of grain size with distribution coefficients gb/sg, mobility ratios in the various regions, and equilibrium constants as parameters. At impurity concentrations normally found in ceramics, the contribution by subgrain boundaries to conductivity may be neglected. The theoretical results are compared to published data for Al_2O_3:Mg, Fe, and Ti.

29345 STEM analysis of grain boundaries in cemented carbides. Sharma, N.K.; Ward, I.D.; Fraser, H.L.; Williams, W.S. (Univ. of Illinois, Urbana). Contract DOE-EY-76-C-02-1198. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 194-196(Mar 1980).

From Fall meeting of the American Ceramic Society; Gaithersburg, MD, USA (14 Nov 1978).

There is controversy over whether the cobalt binder of liquid phase sintered WC forms a continuous skin over the WC particles or whether the carbide grains form a continuous skeleton. It is shown that the atomic Co/W ratio in the 20-A grain boundaries is >3 times larger than that in the grains, supporting the former model.

29346 ZrO/sub 2-x/ (cubic)-ZrO/sub 2-x/ (cubic+tetragonal) phase boundary. Rauh, E.G.; Garg, S.P. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 239-240(Mar 1980).

The boundary between ZrO/sub 2-x/ (cubic) and ZrO/sub 2-x/ (cubic+tetragonal) was studied by mass spectroscopy at <1770°K. The temperature dependence of the ion currents of ZrO^+ and ZrO_2^+ over $ZrO_{1.98}$ and over $ZrO_{1.96}$ was found.

29347 Temperature dependence of the Grueneisen parameter and lattice vibrational frequencies of UC and UN in the range 298 to 2500°K. Momin, A.C.; Karkhanavala, M.D. (Bhabha Atomic Research Center, Bombay, India). *High Temp. Sci.;* **11**: No. 3, 179-185(Sep 1979).

The Grueneisen parameter and the average lattice vibrational frequencies of UC and UN have been evaluated at different temperatures in the range 298 to 2500°K. For both UC and UN, the Grueneisen parameter γ shows a very gradual decrease with increasing temperature, but can be considered almost constant with an average value of 1.6 +- 0.2 over the entire temperature range. The lattice vibrational frequencies decrease with increasing temperature and the percent decrease in the average (geometric mean) lattice vibrational frequencies is found to be 12 +- 2% for UC and 11 +- 2% for UN over this temperature range.

29348 Calorimetric evidence of structural and ferromagnetic transitions in Gd/sub x/Er/sub 1-x/Rh_4B_4. Ho, J.C. (Univ. of California, Berkeley); Huang, C.Y.; Smith, J.L. *J. Phys. (Paris), Colloq.;* **39**: No. 8, C6.381-C6.382(Aug 1978).

Low temperature calorimetric measurements on three Gd/sub x/Er/sub 1-x/Rh_4B_4 samples with x = 0.09; 0.28 and 0.65 indicate a structural transformation near 11°K. The magnetic ordering occurring at lower temperatures have been identified by the heat capacity data as ferromagnetic in nature.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 28524, 29342, 29343

29349 (CONF-780545—11) **Fracture of polycrystalline $MgAl_2O_4$.** Stewart, R.L.; Bradt, R.C. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). 1979. Contract AS02-76ER03420. 20p. NTIS, PC A02/MF A01.

From Meeting of the American Ceramic Society; Detroit, MI, USA (6 May 1978).

The fracture toughness of stoichiometric polycrystalline $MgAl_2O_4$ was measured as a function of grain size and temperature to 1400°C. The room temperature K/sub Ic/'s are comparable to reported single crystal values. No effect of grain size was detected. Two regions of K/sub Ic/ = f(T) were observed, both are a decreasing K/sub Ic/ with an increasing T. In the low temperature region, fracture is of a mixed mode, transgranular and intergranular character and the (dK/sub Ic//dT) decrease is governed primarily by (dE/dT). The high temperature region, T > 900°C, has a much larger (dK/sub Ic//dT) decrease, and a fracture character that is totally intergranular, suggesting dominance by grain boundary processes.

29350 Elastic properties of stabilized HfO_2 compositions. Dole, S.L.; Hunter, O. Jr., Calderwood, F.W. (Iowa State Univ., Ames). Contract W-7405-ENG-82. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 136-139(Mar 1980).

Elastic moduli of several stabilized HfO_2 compositions were studied as functions of porosity and temperature. Thermal expansion was also measured for one of the compositions. The modulus vs porosity and thermal-expansion measurements yielded typical relations. The modulus vs temperature measurements revealed an anomalous nonlinear relation between room temperature and 500°C. Varying microstructural and testing conditions had no effect on the nonlinearity. Only the percent of stabilizer additive caused any change in this behavior. It is proposed that oxygen-vacancy motion is the probable cause of this behavior.

29351 High-temperature deformation of stoichiometric $^{239}PuO_2$. Petrovic, J.J.; Land, C.C. (Los Alamos Scientific Lab., NM). *J. Am. Ceram. Soc.;* **63**: No. 3-4, 201-208(Mar 1980).

From 81. annual meeting of the American Ceramic Society; Cincinnati, OH, USA (30 Apr 1979).

The deformation behavior of stoichiometric $^{239}PuO_2$ was examined at 800° to 1500°C, using direct and diametral compression. Maximum ductility was observed at 1000°C, but above this temperature both strength and ductility decreased and the fracture mode changed from transgranular to intergranular. The deformation activation energy measured at 1000°C was 598 kJ/mol. Comparison to the deformation behavior of hypostoichiometric ^{239}PuO/sub 2-x/ suggests that high-temperature dislocation motion becomes more difficult with increasing O/Pu ratio due to effects of stoichiometry on diffusion rates. Deformation mechanisms in $^{239}PuO_2$ appear to be a combination of dislocation motion and grain-boundary sliding.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 29344, 29348, 29350

29352 (DOE/ER/10462—2) **Band structure and density of states of β-silicon nitride.** Ren, S.Y.; Ching, W.Y. (Missouri Univ., Kansas City (USA). Dept. of Physics). 1980. Contract AC02-79ER10462. 11p. (CONF-800647—5). NTIS, PC A02/MF A01.

From International conference on the physics of MOS insulators; Raleigh, NC, USA (18 Jun 1980).

The electronic energy band structure of β-Si_3N_4 has been calculated using the first principles LCAO method. The bottom of the Conduction Band (CB) is at Γ and the top of the valence band (VB) is located along ΓA line. The very flat top VB along ΓA accounts for a large hole effective mass. The indirect band gap obtained is very close to the experimental value of 5.2 eV. The density of states (DOS) and partial DOS are also obtained and are in good agreement with photoemission data. In the VB region from -20. to -14. eV the states are entirely composed of N 2s states while in the range from -10.5 eV up, the states are predominately N 2p in character. In the CB region, the DOS is dominated by Si 3s and 3p orbital components. These results are consistent with charge analysis which indicates that on average, 0.56 electron is transferred from Si to N per Si-N bond.

29353 (LBL—10687) **Applications of chemical microanalysis to the study of ferromagnetic and ferroelectric ceramics.** Mishra, R.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 17p. (CONF-800801—3). NTIS, PC A02/MF A01.

From Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference; San Francisco, CA, USA (4 Aug 1980).

With the development and perfection of Analytical Electron Microscopy in the last decade, AEM has found increasing application in the study of materials problems. Its application to the study of local chemistry in alloy systems has grown both in width as well as depth. Application of chemical microanalysis to structural ceramic materials has yielded much useful information on hitherto unresolved problems. In this paper, application of chemical microanalysis to the study of common materials science problems such as microsegregation, grain boundary precipitation, decomposition reaction, etc. in ceramic ferrites, garnets, and ferroelectric materials will be outlined with representative examples from the work done at Berkeley. In addition, the significance of these results with respect to the physical properties and processing of these materials are briefly discussed. The limitations and the difficulties involved in studying these materials will also be pointed out.

29354 Coherent neutron scattering study of the vibrations of interstitial deuterium in α-VD/sub 0.7/. Rush, J.J.; Rowe, J.M.; Glinka, C.J.; Vagelatos, N.; Flotow, H.E. (National Measurement Laboratory, National Bureau of Standards, Washington, D.C. 20234). *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5613-5616(15 Jun 1980).

The lattice dynamics of a single crystal of α(bcc)VD/sub 0.7/ have been investigated by coherent inelastic neutron scattering measurements at 295 K. Since the scattering cross section of vanadium is almost entirely incoherent, this study offers a unique opportunity to directly measure the "band" modes associated with vibrational displacements of the light atom interstitials as a function of wave vector (xi-bar) and ω. Transverse and longitudinal acoustic-phonon groups were observed in the three symmetry directions at energies up to 27 meV. These are generally at higher energies than corresponding

modes measured in vanadium by x-ray scattering. The vibrational "density of states" for V and VD/sub 0.7/ are also shown to be grossly different. Careful measurement of the "band-mode" intensities for several different phonon branches as a function of xi-bar and ω indicate that the deuterium motions are strongly coupled to the metal lattice. Peaks due to optical vibrations are also observed, which indicate little dispersion of the optic branches in the crystal.

29355 Extended x-ray-absorption fine-structure studies of electron-lattice correlations in mixed-valence Sm/sub 0.75/Y/sub 0.25/S. Martin, R.M.; Boyce, J.B.; Allen, J.W.; Holtzberg, F. (Xerox Palo Alto Research Center, Palo Alto, California 94304). *Phys. Rev. Lett.;* **44**: No. 19, 1275-1278(12 May 1980).

X-ray absorption spectrum of the Sm L/sub III/ edge has been measured in mixed-valence Sm/sub 0.75/Y/sub 0.25/S. From analysis of the edge structure and extended x-ray absorption fine structure, the valence is determined and it is shown that the S neighbors of each Sm atom adopt an average distance rather than a dynamically distorted environment with two distances corresponding to the two valence states. From this it is concluded that the characteristic Sm 4f-band width is not greatly modified by polaron effects.

29356 Absorption effects in STEM microanalysis of ceramic oxides. Bender, B.A.; Williams, D.B.; Notis, M.R. (Lehigh Univ., Bethlehem, PA). Contract EY-76-S-02-2408. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 149-151(Mar 1980).

From 81. annual meeting of the American Ceramic Society; Cincinnati, OH, USA (1 May 1979).

A scanning transmission electron microscope (STEM) equipped with an x-ray energy dispersive spectrometer (EDS) was used for quantitative x-ray microanalysis of an MgO-10 mol% NiO ceramic. Using the Cliff-Lorimer standardless ratio technique for quantitative x-ray microanalysis, absorption of the Mg characteristic x rays, particularly by oxygen in the specimen, was found to be a critical problem and corrections were required. This problem is characteristic of low atomic number oxide ceramics. However, preferential absorption of characteristic x rays by carbon contamination buildup during x-ray analysis was negligible. A grain-boundary composition profile, corrected for absorption, showed no segregation of the Ni to the grain boundary, in agreement with current segregation theory.

29357 Electrical properties of yttrium-aluminum-silicon oxynitride glasses. Leedecke, C.J. (Sandia Labs., Albuquerque, NM); Loehman, R.E. Contract DE-AC04-76-DP00789. *J. Am. Ceram. Soc.;* **63**: No. 3-4, 190-193(Mar-Apr 1980).

From Fall meeting of the American Ceramic Society; Bedford Springs, PA, USA (12 Oct 1978).

The ac electrical properties of several Y-Al-Si oxynitride glasses were measured as a function of temperature at 20° to 625°C in the frequency range 50 to 10^5Hz. The low-field dc conductivity was also determined. Dispersions in the dielectric constant associated with the peaks in the tan δ curves were observed in all cases. The peaks in tan δ shifted to higher frequencies with increasing temperature. Below ~ 400°C, the ac conductivity was proportional to Ω/sup n/ with $0.5<n<1$. The characteristic relaxation time, tau$_0$, and the density of defect states were estimated using a model consisting of carrier hopping over a potential barrier. At all temperatures the dc conductivity could be described by an Arrhenius equation.

29358 Thermodynamic properties of substoichiometric zirconium dioxide at the lower phase boundary. Ackermann, R.J.; Garg, S.P.; Rauh, E.G. (Argonne National Lab., IL). *High Temp. Sci.;* **11**: No. 3, 199-210(Sep 1979).

The vaporization behavior of the univariant system, Zr(s,l) + ZrO_2 (s), has been investigated by a combination of mass effusion and mass-spectrometric techniques over the temperature range 1900 to 2500°K. The partial pressures of the gaseous species, Zr(g), ZrO_2(g), and O(g), across the miscibility gap and the activities and activity coefficients of Zr and ZrO_2 in the condensed phases have been determined. From these results values for the standard Gibbs energy of formation of the substoichiometric dioxide and the Zr(α) phase saturated with oxygen were calculated as a function of temperature and the corresponding compositions of the phase boundaries.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 28963, 28975, 29054

29359 (HEDL-SA—1979) **Wear and corrosion performance of metallurgical coatings in sodium.** Johnson, R.N.; Farwick, D.G. (Hanford Engineering Development Lab., Richland, WA (USA)). 24 Apr 1980. Contract AC14-76FF02170. 18p. (CONF-800439—10). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

The friction, wear, and corrosion performance of several metallurgical coatings in 200 to 650°C sodium are reviewed. Emphasis is placed on those coatings which have successfully passed the qualification tests necessary for acceptance in breeder reactor environments. Tests include friction, wear, corrosion, thermal cycling, self-welding, and irradiation exposure under as-prototypic-as-possible service conditions. Materials tested were coatings of various refractory metal carbides in metallic binders, nickel-base and cobalt-base alloys and intermetallic compounds such as the aluminides and borides. Coating processes evaluated included plasma spray, detonation gun, sputtering, spark-deposition, and solid-state diffusion.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 29279

POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 29431

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 28592, 29545

29360 (EUR—6737-EN) **Development of a new polyurea foam insulation material. Final report.** Creyf, H. (PRB-Recticel, Wetteren (Belgium)). 1980. 49p. NTIS (US Sales Only), PC A03/MF A01.

It was the aim of this research to develop a low density, self-extinguishing insulation material. The research was carried out on a lab scale, a semi-industrial and an industrial scale. The laboratory research yielded a formulation which could be used on a semi-industrial scale. There, however, two difficulties arose: the appearance of cavities at the bottom of the blocks and a nonlinear rise curve, which could have implications at an industrial scale. However, laboratory investigations revealed that the cavities of the blocks could be overcome when an alcanol amine was added to the formulation. The effect of the nonlinearity of the rise curve could be minimized when a perfect coordination of the mechanical parameters was performed. Further treatment of the blocks consisted of sawing panels and crushing them. The physical parameters of the panels were measured and found to meet the requirements set. Test samples were sent to TNO, and got a positive appreciation. Afterwards, the density of the foam was a little enhanced. An economic evaluation of the application of polyurea foam in a bungalow type house shows to be quite positive.

STRUCTURE AND PHASE STUDIES

29361 Intermolecular vibrational coupling in crystalline m-dinitrobenzene: Polarized infrared spectra of oriented polycrystalline films. Katon, J.E.; Hanai, K.; Tripathi, G.N.R. (Department of Chemistry, Miami University, Oxford, Ohio 45056). *J. Chem. Phys.;* **73**: No. 2, 697-704(15 Jul 1980).

High resolution infrared spectra of oriented crystal films of m-dinitrobenzene have been recorded at about 20 K using polarized radiation. The intermolecular coupling within the unit cell has been observed and is interpreted in terms of the known crystal structure. Symmetry species of the molecular vibrations and their factor group components are determined on the basis of the observed polarization behavior of the crystal bands. Some of the earlier assignments are revised.

29362 Excluded-volume expansion of polymer chains: A Monte Carlo study of the scaling properties. Webman, I.; Lebowitz, J.L.; Kalos, M.H. (Departments of Mathematics and Physics, Rutgers University, New Brunswick, New Jersey 08903). EY-76-C-02-3077. *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5540-5543(15 Jun 1980).

Results are presented of Monte Carlo simulations of continuum-model polymer chains which results confirm the idea that for long chains the degree of expansion due to excluded volume depends on the interaction range σ, on N, the number of links, and on the link size a through a single variable z proportional $(\sigma/a)^3\sqrt{N}$-bar. The expansion factor psi(z) is very close in form to that found by Lax, Barrett, and Domb for lattice models of a polymer. For $z >$ or $= 2$, psi(z) follows a power law predicted by Flory. For finite chains there are corrections to psi(z) which depend on N and on the form of the interaction.

PHYSICAL PROPERTIES

29363 Electron spin resonance and electron nuclear double resonance spectroscopy: Application to the study of trapped electrons. Box, H.C.; Freund, H.G. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14263). EY-765023212. *Appl. Spectrosc.;* **34**: No. 3, 293-295(May 1980).

V band electron spin resonance-ENDOR spectroscopy has been applied to the study of "trapped" electrons in single crystals of polyhydroxy and carbohydrate compounds X-irradiated at low temperature. Evidence is presented from ENDOR measurements of hydroxy proton couplings that electrons are stabilized at intermolecular sites. The electron can be stabilized in the dipole fields of two or three hydroxy groups.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 28590, 28591, 28593, 28594, 28597, 28598, 28599, 28601, 28604, 28605, 28607, 28608, 28609, 28610, 28615, 28616, 28640

29364 (MHSMP—80-30) **Supplemental curing of S-5370 hydrogen blown foam cushions.** Myers, J.C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jun 1980. Contract AC04-76DP00487. 13p. NTIS, PC A02/MF A01.

In a previous investigation the hydrogen blown foam cushions S-5370 were thermally conditioned under significant loads. Results from the load deflection tests gave unexpected compression sets and low load retentions. To determine if the compression sets and poor load retentions were due to inadequate curing, additional curing was conducted on eight virgin S-5370 cushions before they were subjected to thermal and compressive conditioning. Load deflection tests were performed before the additional cure, after the additional cure, and after the thermal and compressive conditioning. Comparisons bewteen the load deflection tests of the additionally cured cushions and control cushions indicated the cured cushions retained more of their resilience than the control cushions. These results indicated additional curing will improve the resilience of the S-5370 hydrogen blown from cushions.

29365 **Silicon surface structures after pulsed laser annealing.** Zehner, D.M.; White, C.W.; Ownby, G.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Surf. Sci.;* **92**: L67-L70(1980).

Low energy electron diffraction observations from Si single crystals following irradiation with a pulsed ruby laser show that the laser annealing induced epitaxial regrowth process extends to the outermost layer of the crystal. Results from a stepped (111) surface show that under these annealing conditions the crystal terminates in a vicinal structure consistent with its physical orientation and contains filled (111) planes.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 29827

29366 **One-dimensional fluctuations and the chain-ordering transformation in Hg/sub 3-δ/AsF$_6$.** Emery, V.J.; Shirane, G. (Brookhaven National Lab., Upton, NY). pp 455-469 of Molecular metals. Hatfield, W.E. (ed.). New York, NY; Plenum Publishing Co. ([nd]).

The mercury ions in Hg/sub 3-δ/AsF$_6$ form arrays of interpenetrating infinite chains with a mean separation between ions which is incommensurate with the AsF$_6$ sublattice. This structure leads to a number of quite remarkable properties. The chains are essentially one-dimensional liquids at room temperature, and are free to flow down extremely narrow channels (~ 7.5 A in diameter) formed by the AsF$_6$ sublattice. At about 120°K, the interchain coupling induces a cooperative freezing transition, which takes place in a quite unusual manner. Theory[2] predicts that the first stage consists in the formation of an ion charge-density wave of wave vector. As the order develops, further charge-density waves with wave vectors are generated harmonically, and their amplitudes grow until the whole assembly becomes an ordered lattice at low temperatures. A complete description of the evolution of long-range order in the chains involves a number of distinct physical processes which are explored in more detail. At high temperatures, the chains are essentially independent and they offer the possibility of studying the behavior of one-dimensional liquids.

PROPERTIES

REFER ALSO TO CITATION(S) 28485, 28524, 28963, 28968, 29298, 29364

29367 **Temperature reversible site structural change for SF$_6$ isolated in an argon matrix.** Swanson, B.I.; Jones, L.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). W-7405-ENG.36. *J. Chem. Phys.;* **73**: No. 2, 986-987(15 Jul 1980).

The temperature dependence of the infrared spectra of the ν_3 region of SF$_6$ in Ar was measured at 8 and 20 °K. (AIP)

29368 **Wake-binding energies in the random-phase approximation.** Echenique, P.M.; Ritchie, R.H. (Cavendish Laboratory, Cambridge, United Kingdom). *Phys. Rev., B: Condens. Matter;* **21**: No. 12, 5854-5856(15 Jun 1980).

The binding energies of electrons trapped in the oscillatory wake of electron-density fluctuations trailing a fast ion in a solid have been evaluated within random-phase approximation linear-response theory. The results are found to be consistent with earlier calculations.

29369 **Chemical vapor deposition of TiB$_2$ on graphite.** Pierson, H.O.; Randich, E.; Mattox, D.M. (Sandia Labs., Albuquerque, NM (USA)). *J. Less-Common Met.;* **67**: No. 2, 381-388(Oct 1979).

From 6. International symposium on boron and borides; Varna, Bulgaria (9 - 12 Oct 1978).

In this paper the authors describe an experimental investigation of the coating of graphite with TiB$_2$ by chemical vapor deposition using the H$_2$ reduction of BCl$_3$ and TiCl$_4$ at 925°C and 1 atm. Reasonable matching of the thermal expansion of TiB$_2$ and graphite was necessary to eliminate cracking. A suitable graphite was POCO DFP-1. Adhesion was improved by using a slightly rough graphite surface. Heat treatment at 2000°C and above resulted in a certain degree of diffusion. No melting or solid phases other than TiB$_2$ and graphite were detected up to 2400°C. The coatings showed no failure when repeatedly submitted to an electron beam pulse of 2 kW cm^{-2} for 0.8 s.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 28485, 28968, 29049, 29494

CHEMISTRY

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 28268

29370 (FE—2710-4) **Instrumental analysis of sulfur compounds in coal process streams. Fourth quarterly technical progress report, July-September 1978.** Jordan, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Oct 1978. Contract AS01-77ET10482. 23p. NTIS, PC A02/MF A01.

Seventy-four selected ΔH°, ΔG°, S°, and C/sub p/° assignments, compiled since the inception of the Project, were assessed critically as a data base for predicting abundances of thirty inorganic sulfur moieties in aqueous coal conversion process streams. The schedule for Task 1 has been extended in order to accommodate possible future requirements, including: generation of user-oriented algorithms, for conveniently obtaining computerized readouts (of mole fractions of specified sulfur compounds as function of redox potential, pH and temperature); generation of conditional abundance profiles, taking into account kinetic blocking by sluggish reactions; broadening of the thermodynamic data base to encompass non-aqueous solvents and additonal sulfur compounds. Samples of actual aqueous and non-aqueous coal conversion process streams have been requested, in order to evaluate the applicability of two electrochemical methods (emanating from work on Task 2) to in-plant analyses, viz., (a) determination of sulfur dioxide by differential pulse voltammetry (DPV) in aqueous solutions, using a rotated glassy carbon disk cathode; (b) determination of dibenzothiophene by DPV in a non-aqueous solvent, using a rotated glassy carbon disk anode.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 28422, 28424, 28427, 28544

29371 **Analysis of uranium in urine by delayed neutrons.** Ide, H.M.; Moss, W.D.; Minor, M.M.; Campbell, E.E. (Los Alamos Scientific Lab., NM (USA)). *Health Phys.;* **37**: No. 3, 405-408(Sep 1979).

A method developed at LASL for the measurement of uranium concentration in water samples by delayed neutron counting (DNC) after reactor irradiation had been applied to urine analysis for the routine monitoring of personnel. For calibration purposes urine solutions were spiked with known amounts of depleted, natural or enriched uranium. Spiked samples were analyzed by DNC, as well as by fluorometric analysis for natural U, and by wet chemical isolation followed by α-measurement for enriched U, and results are compared. The DNC method is shown to be highly reliable and to

have greater precision than the other two methods. The sensitivity and limitations of the DNC method, and experience with routine samples are discussed. For routine use the % ^{235}U in the uranium should be known. DNC can also be used for Pu measurement in urine after accidental exposure if the exposure is known to be ^{239}Pu, but the lower limit of detection is too high for routine monitoring. (author).

CHEMICAL PROCEDURES

29372 Apparatus for use in rapid and accurate controlled-potential coulometric analysis. Frazzini, T.L.; Holland, M.K.; Pietri, C.E.; Weiss, J.R. US Patent Application 069,152. [nd]. 15p.

An apparatus for controlled-potential coulometric analysis of a solution includes a cell to contain the solution to be analyzed and a plurality of electrodes to contact the solution in the cell. Means are provided to stir the solution and to control the atmosphere above it. A potentiostat connected to the electrodes controls potential differences among the electrodes. An electronic circuit connected to the potentiostat provides analog-to-digital conversion and displays a precise count of charge transfer during a desired chemical process. This count provides a measure of the amount of an unknown substance in the solution.

29373 Improved method and apparatus for chromatographic quantitative analysis. Fritz, J.S.; Gjerde, D.T.; Schmuckler, G. US Patent Application 067,855. [nd]. 22p.

An improved apparatus and method are described for the quantitative analysis of a solution containing a plurality of anion species by ion exchange chromatography which utilizes a single element and a single ion exchange bed which does not require periodic regeneration. The solution containing the anions is added to an anion exchange resin bed which is a low capacity macroreticular polystyrene-divinylbenzene resin containing quarternary ammonium functional groups, and is eluted therefrom with a dilute solution of a low electrical conductance organic acid salt. As each anion species is eluted from the bed, it is quantitatively sensed by conventional detection means such as a conductivity cell.

29374 (MLM—2732) Method for the analysis of trapped gas in detonators by gas chromatography. Warner, D.K.; Back, P.S.; Barnhart, B.V. (Mound Facility, Miamisburg, OH (USA)). 24 Jun 1980. Contract AC04-76DP00053. 12p. NTIS, PC A02/MF A01.

A method was developed to extract and then analyze gas trapped in thermally aged detonators. This gas was extracted into an evacuated volume and injected into a gas chromatograph for separation and quantitative analysis. To effect this gas extraction, a device was designed for puncturing the detonator cup and capturing the effused gas. Limited testing of five detonators in this device shows amounts of gas ranging from about 0.5×10^{-7} to 12×10^{-7} moles.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 28328, 28539, 28545, 28546

29375 Crystal and molecular structure of organophosphorus insecticides. 12. Dowco 214. Beckman, D.E.; Jacobson, R.A. (Ames Lab., IA). *J. Agric. Food Chem.;* **27**: No. 4, 712-715(Jul 1979).

The crystal and molecular structure of Dowco 214 [O,O-dimethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate] has been determined by single crystal X-ray techniques. It crystallizes in space group P1 with $\alpha = 11.598$ (2), $b = 13.619$ (3), $c = 8.281$ (1) A, $\alpha = 94.65$ (1), $\beta = 94.87$ (2), and $\gamma = 79.97$ (2)° with four molecules per unit cell (two per asymmetric unit). A modified Patterson superposition procedure yielded an initial model and subsequent least-squares refinement based on 3810 observed reflections ($/F_o/ > 3\sigma F_o$) gave a final residual index of $R = 0.078$. The geometry around the phosphorus is distorted tetrahedral with the P-O bond to the aryl group being somewhat elongated relative to the others, averaging 1.616 (4) A vs 1.560 (4) and 1.547 (4) A. Charge densities as determined by CNDO methods are also presented, along with appropriate distances between positively charged centers.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 28427, 29389, 29652, 29775

29376 Method for detecting trace impurities in gases. Freund, S.M.; Maier, W.B. II; Holland, R.F.; Beattie, W.H. US Patent Application 062,372. [nd]. 11p.

A technique for considerably improving the sensitivity and specificity of infrared spectrometry as applied to quantitative determination of trace impurities in various carrier or solvent gases is presented. A gas to be examined for impurities is liquefied and infrared absorption spectra of the liquid are obtained. Spectral simplification and number densities of impurities in the optical path are substantially higher than are obtainable in similar gas-phase analyses. Carbon dioxide impurity (~ 2 ppM) present in commercial Xe and ppM levels of Freon 12 and vinyl chloride added to liquefied air are used to illustrate the method.

29377 (CONF-800568—1) SSMS near surface analysis of B in irradiated Zircaloy-2: ion implantation standards as a calibration technique. Christie, W.H.; Carter, J.A.; Eby, R.E.; Landau, L.; Musick, W.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From 28. annual conference on mass spectrometry and allied topics; New York, NY, USA (25 May 1980).

Purpose of this study was to determine the amount of ^{10}B contamination on the surface of Zircaloy-2 clad irradiated fuel elements that had been stored in an aqueous solution containing 5000 wt. ppM enriched B. SMSS indicated that the contamination was less than 0.06 $\mu g/cm^2$. (DLC)

29378 (GJBX—109(80)) Interference effects of inorganic ions in natural waters when using the Scintrex UA-3 uranium analyzer. Korte, N.E.; Chessmore, R.B. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jun 1980. Contract AC13-76GJ01664. 15p. NTIS, PC A02/MF A01.

The effects of certain inorganic ions on uranyl luminescence measurements made with a Scintrex UA-3 uranium analyzer are described. Many anions and cations present in natural water systems quench uranyl luminescence. However, the concentration of any one ion is seldom sufficient to cause severe quenching, but the additive effects of several ions often result in a significant suppression of the signal. The method of additions can be used to overcome these interferences.

29379 (INIS-mf—5533, pp 39) Initial results with the on-line mass analysis system RAMA. Evans, H.C. (Queen's Univ., Kingston, Ontario (Canada)); Moltz, D.M.; Vieira, D.J.; Parry, R.J.; Wouters, J.M.; Cerny, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978.

From 7. AINSE nuclear physics conference; Melbourne, Australia (6 Feb 1978).

29380 (KY—704) Mass spectrometer memory refinements required for ultra-precise UF_6 ratio measurements. Smith, R.F.; Jackson, J.M. (Paducah Gaseous Diffusion Plant, KY (USA)). 30 Jun 1980. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

Empirical data demonstrate that a refined memory equation is applicable for precise isotopic ratio measurements of uranium hexafluoride by mass spectrometer. Ultra-high precision mass spectrometer ratio measurements of UF_6 are not appreciably limited by the ion source memory level provided appropriate slope and ratio corrections are applied to the memory factors.

29381 Subnatural linewidth spectroscopy by double optical resonance with two-photon pumping. Wong, J.; Garrison, J.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev. Lett.;* **44**: No. 19, 1254-1257(12 May 1980).

A variant of the double-optical-resonance method is proposed in which the pumping step is a two-photon transition, either stimulated Raman scattering or two-photon absorption. It is shown that the probe linewidth can be minimized by proper choice of pump frequencies and assignment of pump beam propagation directions relative to the probe beam. The minimum linewidth is smaller than the value obtained by the usual one-photon pumping technique, and the method does not require any relations among level spacings.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 28430, 28477, 29643

29382 (RFP-Trans—282) Low-pressure adsorption isotherms of synthetic zeolites. II. Adsorption mechanism and isotherm. Tilenschi, S. Translated from *J. Chim. Phys.;* **66**: No. 5, 889-897(1969). 18p. NTIS, PC A02/MF A01.

On the basis of adsorption measurements the author derived a new isotherm equation describing with reasonable accuracy, particularly at low pressures, the adsorption of gases on molecular sieves. The proposed equation was assumed to be made up of two different terms. While one of them gives the langmuirian (unimolecular) adsorption, the other represents the desorption (or thermal transpiration). Each of the above two terms involves two parameters which can be respectively obtained from: (1) the adsorption at saturation; (2) the characteristic low pressure of the zeolite; and (3) the amount of gas adsorbed at the characteristic low pressure. The fourth parameter was calculated by means of another, more simple, equation using the supplementary assumption that the difference between the energies involved in the process (the initial and final adsorption energies) must reach the lowest possible values. The fit between the calculated isotherms and the experimental data of adsorption on synthetic zeolites appears to be quite satisfactory. The differences found out between the initial and final adsorption - energies, are also within the limits already stated by other authors.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 28283, 28286, 28911

29383 (DOE/ER/03077—166) **Implementation of the GAUSSIAN 78 programs on the NYU VAX/11-780: a probe into basis set and correlation effects on the structure of molecular complexes.** Topiol, S.; Moskowitz, J.W.; Osman, R.; Weinstein, H. (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). Apr 1980. Contract AC02-ER03077. 22p. NTIS, PC A02/MF A01.

The program package is used in a theoretical study of molecular complexes that serve as models of drug receptor interactions. The complexes are of para-hydroxyaniline and meta-hydroxyaniline with formamidinium cation. Results indicate that the description of the nature of interaction obtained at the STO-3G SCF level does not change when the basis set is extended to the 4-31G level or when correlation effects are included to second order in a Moeller-Plesset formulation. 5 figures, 4 tables. (DLC)

29384 (DOE/ER/03158—88) **Study of the chemistry of the [111] GaP planes by atom-probe field-ion microscopy. Report No. 4256.** Yamamoto, M.; Seidman, D.N.; Nakamura, S. (Cornell Univ., Ithaca, NY (USA). Materials Science Center; Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). May 1980. Contract AS02-76ER03158. 9p. (CONF-800730—1). NTIS, PC A02/MF A01.

From 27. international field emission symposium; Tokyo, Japan (7 Jul 1980).

Atom-probe field-ion microscope (FIM) analyses were performed on specimens of the compound semiconductor GaP. Purposes were to show the step-like field-evaporation behavior - corresponding to each atomic layer of the [111] planes - and to determine the chemistry of each plane of atoms. These types of information are of great potential value for the study of a wide range of physical problems involving compound semiconductors. The studies showed that the chemistry of each [111] plane could indeed be determined and that small deviations from stoichiometry within a given plane were also measurable. The overall stoichiometry of GaP was found to be related to the background gas hydrogen and the number of ions field-evaporated per pulse. The observations were explained in terms of possible field-evaporation mechanisms involving the main background gas in the FIM - hydrogen.

29385 (FE—2229-12, pp 50-53) **Ultrahigh vacuum chamber for Raman studies of gases adsorbed on metals.** Stencel, J.M. (Univ. of Kentucky, Lexington); Noland, D.M.; Bradley, E.B.; Frenzel, C.A. Mar 1980.

In Surface structure and mechanisms of gasification catalyst deactivation. Final report.

The ultrahigh vacuum chamber described is beig used to study laser Raman spectra associated with gas adsorption on clean metal surfaces. The system enables sample temperatures from -85° to 600°C to be obtained, and besides surface cleaning capabilities associated with high-temperature oxidation or reduction, it incorporates an Ar^+ sputter gun for surface cleaning. Initial experiments of CO + H_2 adsorption of crystalline Ni surfaces are described and the effects of H_2 and O_2 exposure shown for the 80 cm^{-1} band which results from CO + H_2 adsorption.

29386 (LBL—10812) **XTAL system of crystallographic programs: programmer's manual.** Hall, S.R.; Stewart, J.M.; Norden, A.P.; Munn, R.J.; Freer, S.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 117p. NTIS, PC A06/MF A01.

This document establishes the basis for collaborative writing of transportable computer programs for x-ray crystallography. The concepts and general-purpose utility subroutines described here can be readily adapted to other scientific calculations. The complete system of crystallographic programs and subroutines is called XTAL and replaces the XRAY (6,7,8) system of programs. The coding language for the XTAL system is RATMAC (5). The XTAL system of programs contains routines for controlling execution of application programs. In this sense it forms a suboperating system that presents the same computational environment to the user and programmer irrespective of the operating system in use at a particular installation. These control routines replace all FORTRAN I/O code, supply character reading and writing, supply binary file reading and writing, serve as a support library for applications programs, and provide for interprogram communication.

29387 Infrared and Raman spectra of a sulfur-resistant methanation catalyst. Stencel, J.M.; Bradley, E.B.; Brown, F.R. (Department of Electrical Engineering, University of Kentucky, Lexington, Kentucky 40506). EX-76-C-01-2229. *Appl. Spectrosc.;* **34**: No. 3, 319-323(May 1980).

The infrared and Raman spectra of a sulfur-resistant NiO/Cr_2O_3/$MgSiO_3$ methanation catalyst are presented and compared to the spectra of the catalyst after being reduced, sulfided, and tested for methanation activity. The molecular structure of the catalyst is shown to be represented by NiO and MgO dispersed in a quasi-tridimensional Cr-O-Si network. Reduction and sulfiding reorders this network and alters the SiO/sub n/ coordination while reducing Cr^{6+} to Cr^{3+} or Cr^{2+}. The data indicate that the SO_4^{-2} which is present after sulfiding and methanation testing may have been formed during the methanation reaction.

29388 Use of isotope crossover experiments in investigating carbon-carbon bond-forming reactions of binuclear dialkylcobalt complexes. Bergman, R.G. (Univ. of California, Berkeley). *Acc. Chem. Res.;* **13**: No. 4, 113-120(Apr 1980).

Reactions of the (eta-cyclopentadienyl)dimethyl(triphenylphosphine) cobalt complex that is capable of transferring both alkyl groups to a molecule of CO are discussed. Other examples are reported in which isotope crossover experiments provided a tool for investigation of structural integrity of complexes. Results of studies of the reactions of related mononuclear complexes which have provided information critical to the understanding of the chemistry of binuclear systems are also included. (BLM)

29389 Application of electron-stimulated desorption method for studies of coadsorption process on a platinum foil surface. Drinkwine, M.J.; Dus. R.; Lichtman, D. (Univ. of Wisconsin, Milwaukee). *J. Catal.;* **61**: No. 2, 336-347(Feb 1980).

Using a common purity Pt foil, the character of adspecies adsorbed from the residual gases in a stainless-steel UHV system was studied by the electron-stimulated desorption (ESD) method. Hydrogen adatoms and dissociatively adsorbed water vapor were found as a deposit from the gas phase. The alkali metal ions,Na^+ and K^+, were readily observed by secondary ion mass spectrometry even after sputter cleaning the sample. It is suggested that alkali metal impurities could be the active sites on the Pt surface for dissociative adsorption of water. The fluorine observed on the Pt surface was thought to be a result of surface segregation of fluorine bulk impurities, with the standard enthalpy of segregation being 1600 cal/mole. A correlation between ESD of fluorine and an increase in ESD active surface hydrogen was observed. It is concluded that surface sites released by fluorine desorption are particularly active for hydrogen adsorption. Also, ESD parameters, such as total cross section, ion energy distributions, and the ion yield dependence on electron beam energy, were measured for various adspecies observed on the Pt foil. 12 figures.

29390 Cation complexing properties of synthetic macrocyclic polyether-diester ligands containing the pyridine subcyclic unit. Bradshaw, J.S.; Maas, G.E.; Lamb, J.D.; Izatt, R.M.; Christensen, J.J. (Brigham Young Univ., Provo, UT). Contract ER-78-S-02-5016. *J. Am. Chem. Soc.;* **102**: No. 2, 467-474(16 Jan 1980).

Ten new macrocyclic polyether-diester compounds containing a pyridine subcyclic unit substituted in the 4 position with chloro or methoxy groups have been prepared. These compounds along with their unsubstituted pyridine analogues form strong complexes with alkylammonium and some metal cations. Complexation with alkylammonium and potassium cations was accompanied by significant chemical-shift changes in the ^1H NMR spectra. Relative free energies of activation (ΔG/sup not equal to/) for the dissociation of the alkylammonium complexes were determined from their temperature-dependent ^1H NMR spectra. Complexes of the methoxy-substituted ligands with all the alkylammonium ions studied had a greater ΔG/sup not equal to/ than those of the chloro-substituted ligands. Formation constants as well as ΔH and TΔS values were determined by a calorimetric technique for the reaction of Na^+, K^+, Rb^+, Ag^+, NH_4^+, and Ba^{2+} with the ligands of 18 ring members containing pyridine and 4-chloropyridine subcyclic groups. The complexes formed between the alkali metal cations and these ligands were almost as stable as those formed with 18-crown-6 and pyridino-18-crown-6 (1). The pyridino ligands were also found to be effective carriers of Ag^+ across a $CHCl_3$ liquid membrane separating aqueous phases.

29391 Iron alloy Fischer-Tropsch catalysts. I. Oxidation-Reduction studies of the Fe-Ni system. Unmuth, E.E.; SI. Schwartz, L.H.; Butt, J.B. (Northwestern Univ., Evanston, IL). *J. Catal.;* **61**: No. 1, 242-255(Jan 1980).

The oxidation and reduction behavior of a series of Fe/SiO_2, Ni/SiO_2, and 4Fe:Ni/SiO_2 catalysts, each with total metals loading of 5 wt%, has been investigated. Characterization methods employed were Moessbauer effect spectroscopy, x-ray diffraction, and temperature-programmed reduction. Reduction of the nickel (H_2, 425°C, 12 hr) proceeds directly to the metal and is essentially quantitative, while reduction of α-Fe_2O_3 under the same conditions proceeds via the intermediate Fe_3O_4 and yields about 70% metallic iron. Reduction of 4Fe:Ni results in a biphasic mixture of BCC and FCC alloys, with a nickel FCC phase of ca. 37.5 atom% Ni, which is

approximately the bulk equilibrium value. Finally, there are some changes in particle size and granularity upon oxidation and reduction in all cases. Details of these alterations are discussed. 29 references, 12 figures, 10 tables.

29392 (RFP-Trans—283) **Mechanism of gas fixation on a zeolite. I. Quasi-chemical model of gas adsorption.** Bernache-Assollant, D.; Thomas, G. Translated from *J. Chim. Phys.;* **72**: No. 11-12, 1241-1248(1975). 17p. NTIS, PC A02/MF A01.

A quasi-chemical adsorption model on a zeolite is proposed. The adsorptions in the cavities, the channels, and on the external surface of the zeolite are distinguished. The fixation of the gas in the cavities, which is the most important one, depends upon the cavity considered; so, the distribution of the molecules is not uniform. The isothermal and isobaric curves can be determined as well as in the case of mobile layers as in the case of localized molecules. When the chemical species have no interaction, the theoretical curves can be traced with the knowledge of one parameter only, i.e., the Henry's constant of the gas zeolite system. This model is applied to the study of the sorption of carbon dioxide on zeolites A. It is shown that the adsorption is localized, with some interaction. An ir study is conducted so that the state of carbon dioxide molecules fixed on the solid may be determined. This model can also be applied to other examples.

ISOTOPE EFFECTS

29393 **Tunneling model for hydrogen abstraction reactions in low-temperature solids. Applications to reactions in alcohol glasses and acetonitrile crystals.** Le Roy, R.J. (Univ. of Waterloo, Ontario); Murai, H.; Williams, F. *J. Am. Chem. Soc.;* **102**: No. 7, 2325-2334(26 Mar 1980).

A simple and internally consistent quantitative model for hydrogen-abstraction reactions in low-temperature solids, which implicitly incorporates zero point energy effects which allow for finite reaction rates at T = 0 K, is derived and applied to new measurements of H-abstraction rate constants by methyl radicals in methanol and ethanol glasses at T = 13-99K and in acetonitrile and methyl isocyanide crystals at 69-128 K. Nonlinear least-squares fits of the model to the experimental data yield effective one-dimensional barriers to reaction whose heights are virtually independent of the analytic form used for the potential energy barrier, and are somewhat larger than the activation energies measured for the corresponding reactions in the gas phase. This model predicts that values of the isotopic rate constant ratio k/sub H//k/sub D/ will be larger than 10^{12} at T = 0 K. 8 figures, 6 tables.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

29394 **Photolytic separation of isotopes in cryogenic solution.** Freund, S.M.; Maier, W.B. II; Holland, R.F.; Battie, W.H. US Patent Application 069,151. [nd]. 13p.

Separation of carbon isotopes by photolysis of CS_2 in cryogenic solutions of nitrogen, krypton and argon with 206 nm light from an iodine resonance lamp is reported. The spectral distributionn of the ultraviolet absorption depends on solvent. Thus, in liquid nitrogen the photolytic decomposition rate of $^{13}CS_2$ is greater than that of $^{12}CS_2$ (because the absorption of 206 nm radiation is greater for $^{13}CS_2$), whereas in liquid krypton and liquid argon the reverse is true. The shift in ultraviolet spectrum is a general phenomenon readily characterized as a function of solvent polarizability, and exhibits behavior similar to that for vibrational transitions occurring in the infrared.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 28568, 28569, 28572, 29388, 29390, 29391

29395 (FE—2018-14) **Fundamentals of nitric oxide formation in fossil fuel combustion. Progress report, 29 June-28 September 1979.** Houser, T. (Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry). May 1980. Contract AC01-76ET10593. 12p. NTIS, PC A02/MF A01.

The rate of oxidation of pyridine was determined over a wide range of conditions: temperature range of 675 to 775°C and concentrations 0.25 to 2.0 mole % pyridine and 1 to 7 mole % oxygen. In addition, the oxidation of HCN was examined to determine the extent of NO formation.

29396 **Crystal and molecular structure of organophosphorus insecticides. 9. Stirofos.** Rohrbaugh, W.J.; Jacobson, R.A. (Ames Lab., Iowa State Univ.). *Agricultural and Food Chemistry;* **26**: No. 5, 1120(1978).

The crystal and molecular structure of stirofos (2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate), $(H_3CO)_2PO_2C_8H_3Cl_4$, has been determined by three-dimensional x-ray analysis. The compound crystallizes in the triclinic space group P1: a = 14.023 (4), b = 15,088 (5), c = 6.930 (2) A, α = 93.94 (2), β = 90.29 (4), and γ = 98.97 (4)°. The structure was solved via direct methods and refined to a final residual of R = 0.123. The two molecules per asymmetric unit assume nearly identical configurations with the orientation of the phosphate group relative to the planar organic moiety differing markedly from previous studies of organophosphorus insecticides. The average angle between the P=O bond and the normal to the plane of the ring system was 85.8° compared to 23.7° for ronnel, 38.4° for coroxon, 23.9° for azinphos-methyl, and 23.5° for amidithion. In addition, the partial charge on phosphorus (via a CNDO II molecular orbital calculation) differed considerably from previous studies, i.e., stirofos, +1.385 e; amidithion, +1.063 e; and azinphos-methyl, +1.041 e.

29397 (LA-UR—80-1619) **Picosecond studies of temperature and solvent effects on the fluorescence from coumarin 102 and acridine.** Shapiro, S.L.; Winn, K.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800656—1). NTIS, PC A02/MF A01.

From Picosecond meeting; Falmouth, MA, USA (18 Jun 1980).

Hydrogen bonding characteristics of acridine and coumarin 102 are studied in different solutions. Coumarin 102 upon excitation forms a complex in alcoholic solutions, whereas excited acridine relaxes in aprotic and protic solvents by a process involving an activation energy.

29398 **Carbon-13 nuclear magnetic resonance studies of the monocarboxylic acids of cyanocobalamin. Assignments of the b-, d-, and e-monocarboxylic acids.** Anton, D. (Univ. of Minnesota, Minneapolis); Hogenkamp, H.P.C.; Walker, T.E.; Matwiyoff, N.A. *J. Am. Chem. Soc.;* **102**: No. 7, 2215-2219(26 Mar 1980).

Analysis of the carbon-13 nuclear magnetic resonance spectra of cyanocobalamin, cyanoepicobalamin, cyanocobalamin lactone, cyanocobalamin lactam, and the three monocarboxylic acids derived from cyanocobalamin has led to the revision of the identity of these three monocarboxylic acids. The observed chemical-shift changes identify the peak I, II, and III acids as the d-, b-, and e-monocarboxylic acids of cyanocobalamin, respectively, and demonstrate that the earlier preparations designated CMS_1 or E_2, CMS_2 or E_1, and CMS_3 are Coα-(α-5,6-dimethylbenzimidazolyl)-Coβ-cyanocobamic acid a,c,d,e,g-pentamide, Coα-(α-5,6-dimethylbenzimidazolyl)-Coβ-cyanocobamic acid a,b,c,d,g-pentamide, and Coα-(α-5,6-dimethyl-benzimidazolyl)-Coβ-cyanocobamic acid a,b,c,e,g-pentamide, respectively. 5 figures, 3 tables.

29399 **Mechanism of oxidative cleavage of α-hydroxyalkylchromium complexes.** Espenson, J.H.; Bakac, A. (Ames Lab., IA). Contract W-7405-ENG-82. *J. Am. Chem. Soc.;* **102**: No. 7, 2488-2489(26 Mar 1980).

One key intermediate in the Fischer-Tropsch process may be a metal-bound α-hydroxyalkyl group. Transition metal complexes containing this group are relatively rare and often quite unstable, and thus their chemistry has not been extensively explored. The exceptional chemistry of the hydroxyalkylchromium cations is shown not only by the formation of the reduced metal ion (Cu^+ or Fe^{2+}), but also by the net reduction of chromium to its divalent state: $CrCRR'OH^{2+} + Cu^{2+}$ (or Fe^{3+}) = $Cr^{2} + Cu^{+}$ (or Fe^{2+}) + RR'CO + H^+. The Cr^{2+} produced, unless specifically scavenged is subsequently oxidized by a second mole of Fe^{3+} (rapidly) or Cu^{2+} (slowly). The mechanism of these reactions was investigated by kinetic studies over a wide range of concentrations. The mechanism proposed to account for the major pathway consists of a rapidly established preequilibrium in which the proton of the C-bonded alcohol is replaced by the metal ion oxidant. The very electronegative substituent would be expected to greatly reduce electron transfer from coordinated alcohol to chromium, and an OR group in place of OH would be expected to prevent reaction by this pathway. 1 figure. (DP)

29400 **Synthesis of aliphatic dimeric N-isopropylhydroxamic acids and the crystal and molecular structure of N,N'-dihydroxy-N,N'-diisopropylhexanediamide: a hydroxamic acid in the trans conformation.** Smith, W.L.; Raymond, K.N. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 4, 1252-1255(13 Feb 1980).

A series of dimeric N-isopropylhydroxamic acids, separated by (CH_2)/sub n/ units (n = 4,6,8, and 10), have been synthesized from the acid chlorides and N-isopropylhydroxylamine. The structure of the adipoyl derivative (n = 4) has been determined from single-crystal x-ray diffraction data collected by counter methods. In contrast to all previous hydroxamic acids that have been structurally characterized, the planar hydroxamate groups are trans, with C(O)-N and C=O distances similar to those found in amides. Strong intermolecular hydrogen bonds between the hydroxyl and carbonyl

groups hold the molecules in pleated planes perpendicular to the b axis and compensate for the loss of the intramolecular hydrogen bond of the cis conformation. The intermolecular hydrogen bonds appear to be stronger than the intramolecular hydrogen bonds of the cis conformation, but the latter are entropically favored in solution. The molecules are located on a center of inversion in the space group Pbca with a = 9.3859(3), b = 18.7156(2), and c = 4180(2)A. Full-matrix least-squares refinement on 1217 independent data with $F_o^2 > 3\sigma(F_o^2)$ and all atoms (including hydrogen) anistropic led to an R factor of 3.8%.

29401 Hydrogen abstraction by biradicals. Reactions with tri-n-butylstannane and octanethiol. Encinas, M.V. (Univ. of Notre Dame, IN); Wagner, P.J.; Scaiano, J.C. *J. Am. Chem. Soc.;* **102**: No. 4, 1357-1360(13 Feb 1980).

The biradicals generated in the Norrish type II reaction abstract hydrogen atoms from mercaptans and Bu_3SnH with rate constants of 9 x 10^6 and 1.1 x 10^6 M^{-1} s^{-1}, respectively (for the biradical from γ-methylvalerophenone). The data from competitive and time-resolved experiments are in excellent agreement. The results suggest that the reactivity of radical sites in biradicals is identical with that of the same sites in monoradicals.

29402 Catalyst for the oxidation of methanol to formaldehyde and a method of preparing the catalyst. Cairati, L.; di Fiore, L. (to Euteco S.p.A.). US Patent 4,181,629. 1 Jan 1980. Filed date 19 Jun 1978. 8p.

Catalyst for the oxidation of methanol to formaldehyde usable in the fluidized form in said oxidation, comprising iron and molybdenum oxides on a granular support, said support being a silica or an alumina having a specific surface area not exceeding 1 m^2/g and an overall pore volume not exceeding 0.1 ml/g and said oxides being present in the catayst in an amount not exceeding 2 parts by weight for each 100 parts by weight of the support and in an atomic ratio between molybdenum and iron of from 1.5:1 to about 2.5:1.

29403 (LA-tr—79-24) Studies of the reaction kinetics of the excited state of two coumarin dyes. Zinsli, P.E. Translated from *Z. Angew. Math. Phys.;* **23**: 1003-1005(1972). 7p. (CONF-7210145—1). NTIS, PC A02/MF A01.

From Societe Suisse de Physique autumn meeting; Lucerne, Switzerland (13 Oct 1972).

The excited-state kinetics of the dyes 7-hydroxycoumarin (7-H) and 4-methyl-7-hydroxycoumarin (4-M) were studied using fluorescence in ethanol-water solutions. Rate constants are obtained for low and high water concentrations. 3 figures. (DLC)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 29394, 29649

29404 (BNL—28043) Light induced electron transfer reactions of metal complexes. Sutin, N.; Creutz, C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 22p. (CONF-800734—1). NTIS, PC A02/MF A01.

From 8. International Union of Pure and Applied Chemistry symposium on photochemistry; Seafeld, Austria (13 Jul 1980).

Properties of the excited states of tris(2,2'-bipy-idine) and tris(1,10-phenanthroline) complexes of chromium(III), iron(II), ruthenium(II), osmium(II), rhodium(III), and iridium(III) are described. The electron transfer reactions of the ground and excited states are discussed and interpreted in terms of the driving force for the reaction and the distortions of the excited states relative to the corresponding ground states. General considerations relevant to the conversion of light into chemical energy are presented and progress in the use of polypyridine complexes to effect the light decomposition of water into hydrogen and oxygen is reviewed.

29405 (UCID—18734) Sensitivity of quantum yield for $O(^1D)$ production from ozone photolysis. Wuebbles, D.J.; Tarp, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1980. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01.

Recent laboratory studies have indicated that the quantum yield for $O(^1D)$ production from photolysis of ozone may be less than unity at wavelengths shorter than 300 nm (below the fall off region). Previously it had been assumed that the quantum yield was unity at these wavelengths. Based on the recent work of Brock and Watson (who measured the quantum yield at 266 nm), the effect of assuming a quantum yield of 0.9 for $O(^1D)$ production at wavelengths less than 300 nm in the LLL 1-d model was tested. Since measurements of the quantum yield fall off at longer wavelength also assume unity quantum yield below the fall off region, we also multiplied the $O(^1D)$ quantum yield through this region by 0.9. The remaining quantum yield from the photolysis reaction is assumed to produce $O(^3P)$ at all wavelengths so that the total quantum yield is unity.

29406 Lifetimes, spectra, and quenching of the excited states of polypyridine complexes of iron(II), ruthenium(II), and osmium(II). Creutz, C.; Chou, M.; Netzel, T.L.; Okumura, M.; Sutin, N. (Brookhaven National Lab., Upton, NY). *J. Am. Chem. Soc.;* **102**: No. 4, 1309-1319(13 Feb 1980).

The lifetimes of the excited states formed by 530-nm excitation of polypyridine complexes of iron(II) (FeL_6^{2+}) and osmium(II) (OsL_6^{2+}) have been determined by laser flash-photolysis techniques. The FeL_6^{2+} lifetimes, measured in water at room temperature using picosecond absorption spectrometry, are as follows (L,tau +- σ(ns)):2,2',2"-terpyridine (2.54 +- 0.13); 2,2'-bipyridine (0.81 +- 0.07); 4,4'-dimethyl(2,2'-bipyridine) (0.76 +- 0.04); 1,10-phenanthroline (0.80 +- 0.07); 4,7-(diphenyl sulfonate)-1,10-phenanthroline (0.43 +- 0.03). Lifetimes for the analogous complexes of osmium(II) lie in the range 10-100 ns under the same conditions. Unlike the excited states of $Ru(bpy)_3^{2+}$ and $Os(bpy)_3^{2+}$ (λ/sub max/430-460 nm, $\epsilon \sim 5 \times 10^3\ M^{-1}\ cm^{-1}$), the excited state of $Fe(bpy)_3^{2+}$ does not luminesce or absorb significantly in the visible ($\epsilon < 10^3\ M^{-1}\ cm^{-1}$ at $\lambda \geqq 350$ nm) but does exhibit intense absorption below ~ 325 nm. Rate constants for the quenching of the excited states of polypyridine complexes of osmium(II) and ruthenium(II) by ground-state polypyridine complexes of iron(II), ruthenium(II), and osmium(II) are reported and are ascribed to either electron-transfer or energy-transfer processes. The excited states of tris(2,2'-bipyridine)iron(II) and of bis(2,2',2"-terpyridine)iron(II) undergo reaction with Fe/sub aq/$^{2+}$ (0.5 M H_2SO_4, 25°C) with a rate constant ≦ 1 x 10^7 M^{-1} s^{-1}. Based on a comparison of its properties with those of the luminescent charge-transfer excited states of ruthenium(II) and osmium(II) polypyridine complexes the excited state of FeL_6^{2+} is identified as a ligand-field state. The potential of the excited-state coupled $Fe(bpy)_3^{3+} + e$ in reversible $^*Fe(bpy)_3^{2+}$ is estimated to be + 0.1 V.

29407 Primary quantum yields of ketyl radicals in photoreduction by amines. Abstraction of H from N. Inbar, S.; Linschitz, H.; Cohen, S.G. (Brandeis Univ., Waltham, MA). Contract EY-76-S-02-3117. *J. Am. Chem. Soc.;* **102**: No. 4, 1419-1421(13 Feb 1980).

Results of laser flash photolysis studies of the primary reaction of benzophenone triplet with aliphatic amines in benzene solution are reported. Quantum yield of formation of benzophenone ketyl radical was 0.9 - 1.0. Quantum yields for reduction of ketone also were determined for various amines, and the effects of tert-butyl alcohol on radical formation was investigated. Data indicated that H is not abstracted from $-CH_3$ but is abstracted efficiently from $-NH_2$. The very high quantum yields observed with tertiary and secondary amines were thought to imply exciplex formation, but lower quantum yields with primary amines were conditionally attributed to higher ionization potentials. (BLM)

29408 Cis-trans photoisomerization in $Ru(bpy)_2(OH_2)_2^{2+}$. Crystal structure of trans-$[Ru(bpy)_2(OH_2)(OH)](ClO_4)_2$. Durham, B.; Wilson, S.R.; Hodgson, D.J.; Meyer, T.J. (Univ. of North Carolina, Chapel Hill). Contract ER-78-S-05-6034. *J. Am. Chem. Soc.;* **102**: No. 2, 600-607(16 Jan 1980).

The cis reversible trans photoisomerization of $Ru(bpy)_2(OH_2)_2^{2+}$ in acidic aqueous solution has been investigated. The reaction is independent of the wavelength of irradiation and occurs with quantum yields of 0.043 (cis → trans) and 0.025 (trans → cis). In the presence of ClO_4^- the photochemical oxidation of $Ru(bpy)_2(OH_2)_2^{2+}$ to $Ru(bpy)_2(OH_2)(OH)^{2+}$ occurs and the quantum efficiency for this reaction is linearly dependent on $[ClO_4^-]$. The isomerization and oxidation reactions are interpreted as occurring by a dissociative pathway which results from the thermal population of a low lying d-d state which lies above a lowest lying metal-ligand charge-transfer state. The crystal structure of trans-$[Ru(bpy)_2(OH_2)OH](ClO_4)_2$ has been determined from three-dimensional x-ray counter data. The complex crystallizes in the trigonal space group $P3_121$ with three formula units in a cell of dimensions a = 10.902 (2), c = 17.070 (40 A. The structure has been refined to a final value of the conventional R factor of 0.031 based on 2259 independent observations. The geometry of the complex is roughly octahedral, with Ru-N bonds of 2.090 (3) and 2.099 (3) A. The Ru atom lies on a twofold axis, which constrains the two coordinated oxygen atoms to be equivalent; the additional hydrogen atom formally associated with the water ligand forms a symmetrical hydrogen bond to the hydroxyl ligand on an adjacent ion. The Ru-O distance is 2.007 (3) A.

29409 Photochemistry of 1,5-diaryl-1,5-diketones. Bays, J.P.; Encinas, M.V.; Small, R.D. Jr.; Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **102**: No. 2, 727-734(16 Jan 1980).

The photochemistry of ketones 1-3 of the structure where 1,$R^1 = R^2 = H$, 2,$R^1 = H$; $R^2 = CH_3$, 3,$R^1 = CH_3$; $R^2 = H$, has been examined in solution at room temperature by using quantum yield and laser flash photolysis techniques. Triplet energy migration between the two chromophores leads to complete excitation equilibration. In the case of 3, two triplet states have been characterized, reflecting the syn and anti conformation of the o-methylbenzoyl chromophore. The biradicals produced in the triplet decay have lifetimes of ca. 50 ns in wet acetonitrile, for 1 and 2 and 430 ns in the

case of 3, where it results from abstraction of the benzylic hydrogens. Biradicals are produced from 2 with a quantum yield of 1.0; however, the product yields are considerably lower, even in polar hydroxylic solvents. The effect is attributed to strong intramolecular hydrogen bonding in the biradical.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 28927

29410 Kinetics of light emission from XeI produced from electron beam irradiation of gaseous mixtures of Xe and CF_3I. Grieser, F.; Shimamori, H. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **84**: No. 3, 247-250(7 Feb 1980).

The temporal characteristics of the light emission from XeI* B(1/2) state was studied following electron beam excitation of mixtures of Xe and CF_3I. Two processes were found to be responsible for the formation of the exciplex: (1) a nonionic sequence involving electronically excited states of xenon and ground state CF_3I; (2) an ionic sequence with the main step probably being $Xe_2^+ + I \rightarrow XeI^* + Xe$. The deactivation rate constant of XeI* by CF_3I obtained from emission simulation results was determined to be $5 +- 1 \times 10^{11} M^{-1} s^{-1}$.

29411 Protection against radiation damage to organic crystals. Exciton effects. Ritchie, R.H. (Oak Ridge National Lab., TN (USA)); Pope, M. *Philos. Mag., B;* **40**: No. 6, 503-506(Dec 1979).

The results of Salih and Cosslett (Phil. Mag.; 30: (1974)) on protection against damage to electron-irradiated anthracene and coronene crystals are discussed. An explanation in terms of an exciton-diffusion model is proposed.

29412 Silver atom solvation and desolvation in ice matrices: study of solvation shell geometry by electron spin resonance and electron spin echo methods. Kevan, L.; Narayana, P.A. (Wayne State Univ., Detroit, MI). *Ciencia (Mexico);* **6**: No. 1, 10(1978).

Results of studies of the solvation shell structure of silver atoms in ice matrix at 4°K by electron spin resonance (ESR) and electron spin echo spectrometry are reported. Drastic change in the hyperfine coupling constant of the silver atom was noted when the silver atom initially produced at 4°K was warmed to 77°K and reexamined by ESR at 4°K. This suggested a very drastic rearrangement of the water molecules surrounding the silver atom. The geometric arrangement of water molecules around the silver atom produced at 4°K was what would be expected for a solvated silver ion, indicating that no rearrangement had occurred after the silver atom formed. The addition of a little thermal excitation (heating to 77°K) results in the geometry changes than can be explained by assuming either that a water molecule rotates around one of its OH bands or by the development of a hydrogen bond between the silver atom and one of the first solvation shell water molecules. Optical excitation in the absorption band of the silver atom in the ice matrix at 400nm resulted in desolvation of the silver ion or a reversion to the structure originally obtained by reaction of solver salts in ic matrix with radiation produced electrons. This was best explained by a charge transfer mechanism. (BLM)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

29413 Formation of 1-silacyclopenta-2,4-diene through recoil silicon atom reactions. Siefert, E.E.; Loh, K.L.; Ferrieri, R.A.; Tang, Y.N. (Texas A and M Univ., College Station). Contract EY-76-S-05-3898. *J. Am. Chem. Soc.;* **102**: No. 7, 2285-2289(26 Mar 1980).

[^{31}Si]-1-silacyclopenta-2,4-diene was prepared through the reactions of recoil silicon-31 atoms with butadiene. Its identification was verified by the fact that it was catalytically hydrogenated to [^{31}Si]-1-silacyclopent-3-ene. [^{31}Si]-1-Silacyclopenta-2,4-diene is sensitive to γ-ray irradiation. It is also thermally unstable at a temperature higher than 100°C. Possible mechanisms for its formation are considered. 5 figures, 1 table.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 28481, 28482

29414 Specific sequestering agents for the actinides. III. Polycatecholate ligands derived from 2,3-dihydroxy-5-sulfobenzoyl conjugates of diaza- and tetraazaalkanes. Weitl, F.L.; Raymond, K.N. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 7, 2289-2293(26 Mar 1980).

As part of a program to develop specific sequestering agents for the actinides, we have reported the synthesis of N,N',N'',N'''-tetra(2,3-dihydroxybenzoyl)tetraazacycloalkanes. These tetra(DHB) amodes are potentially octadentate ligands via coordination of the catechol oxygen atoms. We now report the synthesis of the DHB amides of linear tetraaza- and diazaalkanes. Furthermore, sulfonation of these compounds in 20 to 30% SO_3-H_2SO_4 yields exclusively their tetra(5-sulfo-DHB) analogues. The sulfonated derivatives have several properties which make them superior to their precursors with respect to actinide coordination; these properties include increased water solubility, enhanced phenolic acidity, and improved oxidative stability near neutral pH. In vivo tests with mice have shown that tetrameric (5-sulfo-DHB) compounds are generally acutely nontoxic, efficient sequestering agents for the actinides which promote rapid urinary excretion of ^{239}Pu. The tetra(5-sulfo-DHB) derivative of spermine is more effective than any other plutonium sequestering agent yet tested. 4 figures, 1 table.

29415 Volatility and molecular structure of neptunium(IV) borohydride. Banks, R.H.; Edelstein, N.M.; Brock S.; Templeton, D.H.; Zalkin, A. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 2, 620-623(16 Jan 1980).

The structure of $Np(BH_4)_4$ was determined by single-crystal x-ray diffraction methods at 130 K. The crystals are tetragonal, space group $P4_2/nmc$; a = 8.559 (9) A, c = 6.017 (9) A, Z = 2.R = 0.114 for 352 reflections (Mo Kα radiation). The four borohydride ions are disposed tetrahedrally about the Np with Np-B distances of 2.46 (3) A. The boron atoms are connected to the Np atom with triple hydrogen bridge bonds similar to the terminal borohydrides in uranium borohydride. Hydrogen atoms were observed in the Fourier maps and refined. This molecular structure is similar to that found for hafnium and zirconium borohydride, but the space group is different. The vapor pressure, 10 mmHg at 25°C, was measured in the range of -5 to 25°C using a Bourdon gauge.

29416 (UCRL-Trans—11570) Studies on the accuracy of calculations of the γ spectrum of fission products. Pulz, E.; Krueger, F.W. Translated from *Kernenergie;* **19**: No. 10, 299-306(1976). 16p. NTIS, PC A02/MF A01.

With the AKTIVIST III Program, characteristics were calculated for fission products generated in the prompt fission of ^{235}U by thermal neutrons. The calculated total γ spectrum of the fission products was compared with experimental and theoretical results. The comparisons show that the spectrum calculations achieved good accuracy.

RADIOISOTOPE PRODUCTION

29417 Conversion of isotope compounds to metals by reduction-distillation methods. Kobisk, E.H.; Adair, H.L. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Nucl. Instrum. Methods;* **167**: No. 1, 153-160(Dec 1979).

From 7. annual meeting of the International Nuclear Target Development Society; Garching, Germany, F.R. (11 - 14 Sep 1978).

Because isotopes in metal form provide physicists with mononuclidic targets essentially void of extraneous or interfering nuclei in two-body experiments, conversions of compounds to metals warrant extensive study. Furthermore, having isotopes in pure metallic form permits (in many cases) physical manipulations to be performed so as to convert bulk material into suitable target configurations; thin foils, wires, castings, spheres, and even colloidal suspensions. Physical properties of metals are extensively influenced by small impurity concentrations, and therefore whatever conversion method is applied, it must preserve and/or create an ultrapure product. The purpose of this paper is to discuss the application of the reduction of a solid compounded isotope, followed by metal distillation into a non-contaminating collector vessel. A variety of isotope metal vapor condensation-collection methods and subsequent treatment of the product to form various physical forms will be discussed. Unfortunately, no single collection technique is applicable to all elements. Limitations of this technique with regard to reducible cations other than those noted earlier will be discussed, together with the consequences of volatilization of some metal suboxides in this process.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 28390, 29395

29418 (DOE/ER/05773—2) Characteristic parameters in combustion processes and their accessibility to current and future diagnostics. Annual report. Goulard, R. (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). 1 May 1980. Contract AS05-78ER05773. 21p. NTIS, PC A02/MF A01.

A review of current combustion research shows a growing awareness of the potential offered by the new high speed three-dimensional techniques. Some of the recent advances in the fluid dynamics of jet mixing are discussed, with an emphasis on the 10 kHz range (especially vortex shedding). Also the very fast subnanosecond range of radical kinetics is investigated, as well as the comparably fast scattering and fluorescence processes. High speed diagnostics are discussed in these two ranges of time resolution, with an emphasis on optical tomography for the fluid dynamic time range (10^{-4} s) and on picosecond techniques for the physical chemistry range (10^{-9} s). This work was carried out during the period June 1, 1979 to May 31, 1980.

29419 (SAND—80-8616) **Comparison of coherent and spontaneous Raman combustion diagnostics.** Rahn, L.A.; Mattern, P.L.; Farrow, R.L. (Sandia Labs., Livermore, CA (USA)). Jun 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

Detectivities are calculated for background substraction coherent anti-Stokes Raman scattering (CARS), inverse Raman scattering (IRS) and spontaneous Raman scattering (RS) for a wide range of pressures and temperatures applicable to combustion environments. The capability of each of these techniques to reject the background luminosity typical of real combustion environments is established quantitatively. Examples of spectra from CARS and IRS flame experiments are shown, and the complementary features of these techniques are discussed.

ENGINEERING

GENERAL ENGINEERING

29420 **Preset pivotal tool holder.** Asmanes, C. (to Dept. of Energy). US Patent 4,172,398. 30 Oct 1979. Filed date 28 Feb 1978. 4p.

PAT-APPL-881,966.

A tool fixture is provided for precise pre-alignment of a radiused edge cutting tool in a tool holder relative to a fixed reference pivot point established on said holder about which the tool holder may be selectively pivoted relative to the fixture base member to change the contact point of the tool cutting edge with a workpiece while maintaining the precise same tool cutting radius relative to the reference pivot point. 2 claims.

29421 **Method for making glass nonfogging .** Lord, D.E.; Carter, G.W.; Petrini, R.R. (to Dept. of Energy). US Patent 4,169,280. 25 Sep 1979. Filed date 13 Jul 1978. 4p.

PAT-APPL-924,337.

A method is presented for rendering glass nonfogging (to condensation for) by sandwiching the glass between two electrodes such that the glass functions as the dielectric of a capacitor, a large alternating current (ac) voltage is applied across the electrodes for a selected time period causing the glass to absorb a charge, and the electrodes are removed. The glass absorbs a charge from the electrodes rendering it nonfogging. The glass surface is undamaged by application of the ac voltage, and normal optical properties are unaffected. This method can be applied to optical surfaces such as lenses, auto windshields, mirrors, etc., wherever condensation fog on glass is a problem. 3 claims.

29422 **Tool holder for preparation and inspection of a radiused edge cutting tool.** Asmanes, C. (to Dept. of Energy). US Patent 4,162,593. 31 Jul 1979. Filed date 28 Feb 1978. 4p.

PAT-APPL-881,965.

A tool holding fixture is provided for removably holding a radiused edge cutting tool in a tool edge lapping apparatus. The fixture allows the operator to preset the lapping radius and angle before the tool holder is placed in the fixture and the holder may be removed from the lapping apparatus to inspect the tool and simply replaced in the fixture to continue lapping in accordance with a precise alignment without realignment of the tool relative to the lap. The tool holder includes a pair of self aligning bearings in the form of precision formed steel balls connected together by a rigid shaft. The tool is held by an arm extending from the shaft and the balls set is fixed position bearing cups and the holder is oscillated back and forth about a fixed axis of rotation to lap the tool radius by means of a reversibly driven belt-pulley arrangement coupled to the shaft between the bearings. To temporarily remove the holder, the drive belt is slipped over the rearward end of the holder and the holder is lifted out of the bearing cups. 4 claims.

FACILITIES AND EQUIPMENT

29423 **Miniature quartz resonator force transducer.** EerNisse, E.P. US Patent Application 031,810. [nd]. 7p.

The invention relates to a piezoelectric quartz force transducer having the shape of a double-ended tuning fork.

29424 **Optical device.** Brunsden, B.S. US Patent Application 031,809. [nd]. 36p.

A device is presented for radially translating radiation in which a right circular cylinder is provided at each end thereof with conical prism faces. The faces are oppositely extending and the device may be severed in the middle and separated to allow access to the central part of the beam. Radiation entering the input end of the device is radially translated such that radiation entering the input end at the perimater is concentrated toward the output end at the perimater is concentrated toward the output end at the perimater is concentrated toward the output central axis and radiation at the input central axis is dispersed toward the output perimeter. Devices are disclosed for compressing beam energy to enhance drilling techniques, for beam manipulation of optical spatial frequencies in the Fourier plane and for simplification of dark field and color contrast microscopy. Both refracting and reflecting devices are disclosed.

29425 **Shuttleless toroid winder.** Lindenmeyer, C.W. US Patent Application 028,742. [nd]. 28p.

A lower support receives a toroid at a winding station with the axis of the toroid aligned with a slot in the support. An upper guide member applies an axial force to hold the toroid against the lower support. A pair of movable jaws carried by an indexing mechanism engage the outer surface of the toroid to apply a radial holding force. While the toroid is thus held, a wire is placed axially through the toroid, assisted by a funnel-shaped surface in the upper guide mamber, and is drawn tight about the toroid by a pair of cooperating draw rollers. When operated in the full cycle mode, the operator then actuates a switch which energizes a power drive to release the axial clamp and to drive the indexing mechanism and the jaws to rotate the toroid about its axis. At the same time, the wire is ejected from the draw rollers beneath the toroid so that the operator may grasp it to form another loop. When the toroid is fully indexed, the jaws release it, and the upper guide member is returned to clamp the toroid axially while the indexing mechanism is returned to its starting position. The apparatus may also be operated in a momentary contact mode in which the mechanism is driven only for the time a switch is actuated.

29426 **Apparatus for correcting precision errors in slide straightness in machine tools.** Robinson, S.C.; Gerth, H.L. US Patent Application 022,898. [nd]. 10p.

The present invention is directed to a mechanism by which small deviations in slideway straightness and roll of a precision machining apparatus may be compensated for. The mechanism of the present invention comprises a fixture support disposed between the slideway carriage and the tool or workpiece fixture and provided with a hinge-like coupling between the carriage and the fixture support so as to allow for the minute and precise displacement of the fixture support in a direction normal to the direction of the slide path soa as to readily compensate for slight deviations in the straightness and roll of the slide path.

29427 **Improved tool grinding machine.** Dial, C.E. Sr. US Patent Application 022,895. [nd]. 10p.

The present invention relates to an improved tool grinding mechanism for grinding single point diamond cutting tools to precise roundness and radius specifications. The present invention utilizes a tool holder which is longitudinally displaced with respect to the remainder of the grinding system due to contact of the tool with the grinding surface with this displacement being monitored so that any variation in the grinding of the cutting surface such as caused by crystal orientation or tool thicknesses may be compensated for during the grinding operation to assure the attainment of the desired cutting tool face specifications.

29428 **Small diameter, deep bore optical inspection system.** Lord, D.E.; Petrini, R.R.; Carter, G.W. US Patent Application 039,985. [nd]. 15p.

An improved rod optic system for inspecting small diameter, deep bores is described. The system consists of a rod optic system utilizing a curved mirror at the end of the rod lens such that the optical path through the system is bent 90^{9} to minimize optical distortion in examing the sides of a curved bore. The system is particularly useful in the examination of small bores for corrosion, and is capable if examing 1/16 inch diameter and up to 4-inch deep drill holes, for example. The positioning of the curved mirror allows simultaneous viewing from shallow and righ angle points of observation of the same artifact (such as corrosion) in the bore hole. The improved rod optic system may be used for direct eye sighting, or in

combination with a still camera or a low-light television monitor; particularly low-light color television.

29429 (BDX—613-2387) **Finite element stress analysis of a compression mold. Final report.** Watterson, C.E. (Bendix Corp., Kansas City, MO (USA)). Mar 1980. Contract AC04-76DP00613. 34p. NTIS, PC A03/MF A01.

Thermally induced stresses occurring in a compression mold during production molding were evaluated using finite element analysis. A complementary experimental stress analysis, including strain gages and thermocouple arrays, verified the finite element model under typical loading conditions.

29430 (BDX—613-2400) **Training manual for precision hand deburring, Part 1.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). May 1980. Contract AC04-76DP00613. 194p. NTIS, PC A09/MF A01.

Part 1 is presented of 4 parts of a training manual to be used by machinist trainees, production workers, and others removing burrs from precision miniature parts. The manuals are written to be self-teaching and are intended to be used with two hours of training each day and are intended to be used with two hours of training each day along with another six hours of bench work in deburring.

29431 (BDX—613-2425) **Syntactic foam supports. Final report.** McIlroy, H.M. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 43p. NTIS, PC A03/MF A01.

Foams consisting of blends of a polyimide resin and glass microbubbles were prepared to provide thermal protection and energy absorption. With the selected type of glass microbubble, tests wre conducted to measure the effect of foam formulation, microbubble strength, and molding pressure on certain mechanical, thermal, and environmental properties.

29432 (BDX—613-2431) **precision deburring using NC and robot equipment. Final report.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). May 1980. Contract AC04-76DP00613. 85p. NTIS, PC A05/MF A01.

Deburring precision miniature components is often time consuming and inconsistent. Although robots are available for deburring parts, they are not precise enough for precision miniature parts. Numerical control (NC) machining can provide edge break consistencies to meet requirements such as 76.2-μm maximum edge break (chamfer). Although NC machining has a number of technical limitations which prohibits its use on many geometries, it can be an effective approach to features that are particularly difficult to deburr.

29433 (CONF-800652—1) **LEW-II: new Lightning Early Warning System at Sandia National Laboratories.** Boettger, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 15p. NTIS, PC A02/MF A01.

From DOE engineering safety conference; Las Vegas, NV, USA (1 Jun 1980).

Improvements made in the Lightning Early Warning (LEW) System at Sandia are described. The improvements include a new more flexible display unit; redesign of the sensor system for a total rf system; updating the computer system; and a new Radio Frequecy Potential Gradient Monitor (RFPG-II). (LCL)

29434 (DOE/ER/10518—1) **Thermoeconomics of energy systems. Progress report, 1 October 1979-1 June 1980.** Tribus, M.; El-Sayed, Y.M. (Massachusetts Inst. of Tech., Cambridge (USA)). 13 Jun 1980. Contract AC02-79ER10518. 105p. NTIS, PC A06/MF A01.

A method for combining thermodynamic and economic analyses is described. The purpose is to make the economic consequences of design decisions apparent during the design process. In conventional methods of design, the thermodynamic and economic analyses are conducted sequentially. By developing a method for treating the two disciplines concurrently it is hoped that better designs will result. The method is similar in philosophy to conventional approaches to thermodynamic analyses. The system is divided into sub-systems upon which energy, entropy, material and economic balances are made. In addition to tracking the thermodynamic variables (temperature, pressure, composition, energy, enthalpy, entropy, free energy, etc.) the thermoeconomic approach also tracks the destruction of generalized availability (essergy destruction) and generalized value (essergy added value and capital destruction). These are called to the designer's attention by a series of measures applied to each zone defining (in a manner analagous to second law efficiencies) the maximum attainable economic improvement associated with each zone. A simplified gas turbine cycle is used to illustrate, in a step-by-step analysis, how the method works. Numerical examples are also given for more complex systems.

29435 (SAND—80-1433C) **Acceleration/vibration combined environment activities. Interim report.** Shuman, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 26p. (CONF-800574—3). NTIS, PC A03/MF A01.

From IMOG meeting held on subgroup environmental testing; Albuquerque, NM, USA (20 May 1980).

The combining of two environments, i.e., linear acceleration and vibration, for use in laboratory testing to determine the damage to some mechanical devices when simultaneously subjected to these two environments, is discussed. The use of a Genisco centrifuge with an Unholtz-Dickie vibration machine mounted on it is described. Initial efforts at operating a shaker on the centrifuge have not been completely successful, so modifications to the system are being made. (LCL)

29436 (SAND—80-8006) **Teaching manual for the TREBEL model FVD 500 balancing machine.** Achin, K. (Sandia Labs., Livermore, CA (USA)). Jun 1980. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01.

The TREBEL Aerospace Balancing System is a vertical, two plane dynamic balancing machine. Static and dynamic unbalance can be read out directly. Assuming the user has no familiarity with static and dynamic unbalance, this manual teaches how to operate and maintain the system, with drawings and photographs to illustrate all controls.

29437 **Pressure regulator.** Ebeling, R.W. Jr.; Weaver, R.B. (to Dept. of Energy). US Patent 4,167,819. 18 Sep 1979. Filed date 5 Dec 1977. 4p.

PAT-APPL-857,649.

The pressure within a pressurized flow reactor operated under harsh environmental conditions is controlled by establishing and maintaining a fluidized bed of uniformly sized granular material of selected density by passing the gas from the reactor upwardly therethrough at a rate sufficient to fluidize the bed and varying the height of the bed by adding granular material thereto or removing granular material therefrom to adjust the backpressure on the flow reactor. 2 claims.

29438 **Negatively buoyant slot jets.** Shahrabani, D.M. (Quirk Associates, Wayne, NJ); Ditmars, J.D. pp 2976-2993 of Fifteenth coastal engineering conference. New York, NY; American Society of Civil Engineers (1977).

From 15. conference on coastal engineering; Honolulu, HI, USA (11 Jul 1976).

The behavior of negatively buoyant slot jets discharged from near the bottom of stagnant and flowing receiving-water environments of uniform density was studied in laboratory experiments. In particular, the locations of the maximum height of rise and maximum horizontal displacement were determined as well as the centerline dilutions at those points. Experiments in stagnant environments were conducted for discharges at angles of 30°, 45°, 60° and 90° from the horizontal and with discharge densimetric Froude numbers of 10, 20, 30, 40 and 50. For flowing environments, discharges at angles of 45° and 90° for the same range of densimetric Froude numbers were directed into uniform currents with discharge to ambient velocity ratios of 15 and 25. The reattachment eddy formed between the jet and bottom boundary was found to have significant effects on the slot jet trajectories and dilutions. Dilutions at the maximum height of rise and maximum horizontal displacement were less than those predicted for slot jets far removed from the influence of the bottom boundary. The strictly two-dimensional discharges studied provide lower bounds on the dilutions to be expected for the cases of slots of finite length or merged multiport diffuser discharges in which the reattachment eddy is not as well developed.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 29299

29439 **Ductile alloy and process for preparing composite superconducting wire.** Verhoeven, J.D.; Finnemore, D.K.; Gibson, E.D.; Ostenson, J.E. US Patent Application 019,808. [nd]. 16p.

An alloy for the commercial production of ductile superconducting wire is prepared by melting together copper and at least 15 weight percent niobium under non-oxygen-contaminating conditions, and rapidly cooling the melt to form a ductile composite consisting of discrete, randomly distributed and oriented dendritic-shaped particles of niobium in a copper matrix. As the wire is worked, the dendritic particles are realigned parallel to the longitudinal axis and when drawn form a plurality of very fine ductile superconductors in a ductile copper matrix. The drawn wire may be tin coated and wound into magnets or the like before diffusing the tin into the wire to react with the niobium. Impurities such as aluminum or gallium may be added to improve upper critical field characteristics.

29440 (BNL—27976) **Effects of irradiation and mechanical stress on the superconducting properties of candidate magnet conductors.** Snead, C.L. Jr.; Luhman, T. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 60p. NTIS, PC A04/MF A01.

The effects of radiation damage on the superconducting critical properties of candidate magnet materials are reviewed. Neutron, and charged-particle irradiation results are covered. The discussion is restricted to effects in NbTi and the A15-compound superconductors. The utility of these conductors in radiation fields is first explored by defining the magnitude of critical-property changes with the fluence of various irradiating particles. The physical mechanisms that couple the irradiation defects to the observed critical-property changes are discussed. Annealing/recovery data on irradiated materials are included where they pertain to the understanding of the physical mechanisms involved, and thereby to the desirability of magnet annealing in actual operating circumstances.

29441 (LBL—10977) **Construction and testing of a double acting bellows liquid helium pump.** Burns, W.A.; Green, M.A.; Ross, R.R.; Van Slyke, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 8p. (CONF-800631—6). NTIS, PC A02/MF A01.

From 8. international cryogenic engineering conference; Genoa, Italy (3 Jun 1980).

The double acting reciprocating bellows liquid helium pump built and tested at the Lawrence Berkeley Laboratory is described. The pump is capable of delivering 50 gs^{-1} of liquid helium to supply the two-phase cooling sytem for a large superconducting magnet. The pump is driven by a torque motor at room temperature; the reciprocating motion is transmitted to the pump through a shaft which operates between room temperature and 4°K. The design details of this liquid helium pump are presented. The helium pump has operated in a helium bath and in pumped forced flow helium circuits. The results of these experimental tests are presented in this report.

29442 **High specific heat superconducting composite.** Steyert, W.A. Jr. (to Dept. of Energy). US Patent 4,171,464. 16 Oct 1979. Filed date 27 Jun 1977. 6p.

PAT-APPL-810,444.

A composite superconductor formed from a high specific heat ceramic such as gadolinium oxide or gadolinium-aluminum oxide and a conventional metal conductor such as copper or aluminum are insolubly mixed together to provide adiabatic stability in a superconducting mode of operation. The addition of a few percent of insoluble gadolinium-aluminum oxide power or gadolinium oxide powder to copper, increases the measured specific heat of the composite by one to two orders of magnitude below the 5°K while maintaining the high thermal and electrical conductivity of the conventional metal conductor. 15 claims.

PROTECTIVE STRUCTURES AND EQUIPMENT

29443 (UCRL—83749) **Electrofibrous prefilters for use in the nuclear industry.** Bergman, W.; Taylor, Hebard, H.D.; Lum, B.Y.; Kuhl, W.D.; Boling, R.M.; Buttedahl, O.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1980. Contract W-7405-ENG-48. 42p. (CONF-800334—14). NTIS, PC A03/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

High efficiency particulate air (HEPA) filters are used in the nuclear industry to remove radioactive aerosols. Although these HEPA filters are effective and practical devices, they generate a large volume of radioactive waste and are costly to purchase and operate. In an effort to reduce the HEPA's operational cost and volume of radioactive waste, the Department of Energy (DOE) has contracted with LLNL to develop electrofibrous prefilters to extend the service life of HEPA filters. A comprehensive program has been established to conduct theoretical modelling, small-scale laboratory experiments, prototype development and field evaluations of electrofibrous prefilters. The recent prototype development and field evaluations of this program are reviewed. Compared to a conventional fibrous filter, the electrofibrous filter has a much higher efficiency and a greater service life. The higher efficiency results from electrostatic forces that attract particles to the filter fibers. This electrostatic attraction also causes particles to form a less restrictive deposit around the fibers thereby increasing the filter service life. The electrofibrous filters discussed are generated by applying an electric field across a conventional fibrous filter. Prototype electrofibrous filters have been developed for use in glove boxes and ventilation systems. The results from two field evaluations in radioactive glove boxes indicate the electrofibrous prefilter greatly increases the service life of HEPA filters. In addition, these evaluations show that most of the radioactive material can be recovered from the prefilter.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 28440, 28441, 28450, 28528, 28529, 28530, 28531, 28532, 29459

29444 **Glove box shield.** Brackenbush, L.W.; Hoenes, G.R. US Patent Application 036,257. [nd]. 12p.

A shield for a glove box housing radioactive material is comprised of spaced apart clamping members which maintain three overlapping flaps in place therebetween. There is a central flap and two side flaps, the side flaps overlapping at the interior edges thereof and the central flap extending past the intersection of the side flaps in order to insure that the shield is always closed when the user wthdraws his hand from the glove box. Lead loaded neoprene rubber is the preferred material for the three flaps, the extent of lead loading depending upon the radiation levels within the glove box.

29445 **Regulatory history and status of nuclear criticality safety research.** Odegaarden, R.H.; Solberg, D.E. (Nuclear Regulatory Commission, Washington, DC). *Trans. Am. Nucl. Soc.;* 33: 357-358(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29446 **Experimental programs at Rockwell International's RFP critical mass laboratory.** McCarthy, J.D. (Rockwell International, Golden, CO). *Trans. Am. Nucl. Soc.;* 33: 360-361(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29447 **Methods development for criticality safety analysis.** Westfall, R.M. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 361-362(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29448 **Reactivity effect of cross-section processing for moist bulk-oxide criticals.** Bucholz, J.A.; Westfall, R.M. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 368-372(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29449 **Improved criticality search techniques for low-and high-enriched systems.** Lorek, M.J. (Univ. of Tennessee, Knoxville); Dodds, H.L.; Petrie, L.M.; Westfall, R.M. *Trans. Am. Nucl. Soc.;* 33: 372-374(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 28440, 28441, 28446, 28447, 28448, 28449, 28450, 28476, 28500

29450 **Accident resistant transport container.** Anderson, J.A.; Cole, K.K. US Patent Application 018,098. [nd]. 12p.

The invention relates to a container for the safe air transport of plutonium having several intermediate wood layers and a load spreader intermediate an inner container and an outer shell for mitigation of shock during a hypothetical accident.

29451 (CONF-780506—(Vol.1), pp 17-27) **Standardize or not to standardize: the pros and cons of standardized designs for casks and cask transport systems.** Brobst, W.A.; Chais, M. (Dept. of Energy, Washington, DC). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

There are many different cask designs that have been approved, built, and used over the years. Some special-use vehicles have been built. In the US, there are now over a dozen current use casks. With a sharp increase in the number of spent fuel shipments coming up in the next decade, and the beginning of high-level waste shipments in the late 1980's, there could be a proliferation of cask and transport vehicle designs. But is this a good idea. Should there be more casks of fewer designs, or are custom-designed casks and vehicles a better way to go. This paper examines the advantages and disadvantages of standardized designs for casks and cask transport systems. Factors of safety, economics, efficiency, and public acceptance are considered. Examples of other transport hardware standardization are given and evaluated. The effects of cask standardization on reactor and processing plant design and operations are examined, as well as the effects of plant standardization on the transport system. This is a chicken and egg situation, and will require close cooperation between designers of transport system hardware and plant hardware.

29452 (CONF-780506—(Vol.1), pp 52-58) **Conceptual design of a shipping cask for rail transport of solidified high level waste.** Rhoads, R.E.; Peterson, P.L. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

No commercial facilities to reprocess spent fuel from light water reactors are currently in operation in the US. Whether or not such facilities will be operated during the remainder of this century is currently a topic of national debate. If it is decided to proceed with the reprocessing option, much work remains to be done to develop commercial facilities to solidify the liquid high level waste generated from the process, transport it to a federal repository and isolate it from the environment. The Department of Energy is currently conducting a variety of research activities in these areas so that reprocessing facilities could be developed and operated in a timely fashion if the decision to use this technology is made. This paper reports the results of a study to develop a conceptual design for a shipping cask to transport solidified high level waste from a reprocessing plant to a federal repository by rail. Scale models of the cask design and accompanying graphics displays have also been developed. The design of a shipping container for radioactive materials is dependent on a variety of design constraints. The design constraints important to development of a cask for shipping solidified high level waste are reviewed. Since commercial facilities to solidify high level waste have not been operated, assumptions based on current technology were made concerning the properties of the solidified high level waste that would be shipped.The conceptual cask would transport nine canisters of waste. The canisters are assumed to be 0.3 m in diameter and 3 m long. Possible cask configurations for other canister sizes are described.

29453 (CONF-780506—(Vol.1), pp 69-74) **Uranium-lead shielding for nuclear material transportation systems.** Lusk, E.C.; Miller, N.E.; Basham, S.J. Jr. (Battelle Columbus Labs., OH). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The basis for the selection of shielding materials for spent fuel shipping containers is described with comments concerning the favorable and unfavorable aspects of steel, lead, and depleted uranium. A concept for a new type of material made of depleted uranium and lead is described which capitalizes on the best cask shielding characteristics of both materials. This cask shielding is made by filling the shielding cavity with pieces of depleted uranium and then backfilling the interstitial voids with lead. The lead would be bonded to the uranium and also to the cask shells if desired. Shielding density approaching 80 percent of that of solid uranium could be achieved, while a density of 65 percent is readily obtainable. This material should overcome the problems of the effect of lead melting in the fire accident, high thermal gradients at uranium-stainless steel interfaces and at a major reduction in cost over that of a solid uranium shielded cask. A development program is described to obtain information on the properties of the composite material to aid in design analysis and licensing and to define the fabrication techniques.

29454 (CONF-780506—(Vol.1), pp 91-101) **Investigation of blanket-type insulation as a replacement for vermiculite in the DOT-6L specification container.** Taylor, J.M. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

As required by ERDA Directive IAD 0529-2, the currently-used DOT-6L specification container, which is filled with those vermiculite as an insulating medium, must be modified, replaced, or provided with an insulating material that would not be lost in an accident that punctured the drum wall. Because of modification or replacement of the 6L container would be costly, a substitute insulating material that is not free-flowing was sought. Based on availability, cost factors, and ease of installation, two blanket-type insulating materials, Kaowool and Fiberglas, were selected for thermal tests. The insulating qualities of these materials were compared with those of vermiculite using furnace tests that simulated the temperature environment of a 1475°F (802°C) fire. Neither Kaowool nor Fiberglas insulated the contents of the 6L container as well as vermiculite. The centerline temperature was 23° higher with Kaowool and 173° higher with Fiberglas than with vermiculite. The tests also indicated that none of the insulating materials, including vermiculite, could maintain the centerline temperature inside the container below 300°F (149°C). The heat input into the innner 2R pipe was attributable to the low thermal resistance of the steel rod supports and braces that are welded to the 2R pipe and in contact with the drum wall.In order to maintain a centerline temperature below 300°F, the 6L container design would have to be changed to isolate the inner 2R pipe from the rod spacers and braces by an insulating material. Considering the cost of converting the large inventory of 6L containers in use and the inability of any of the tested insulating materials to keep the centerline temperature below 300°F, consideration should be given to changing the regulations so that only solid materials that do not decompose below 750°F (399°C) could be packaged in the 6L container.

29455 (CONF-780506—(Vol.1), pp 384-390) **Use of endochronic plasticity theory in modeling the dynamic inelastic response of shipping containers: a preliminary assessment.** Lin, H.C.; Hsieh, B.J.; Valentin, R.A. (Argonne National Lab., IL). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Comprehensive structural design and risk assessment of shipping containers used in energy material transportation systems, particularly in the shipment of radioactive materials, requires accurate computer modeling of dynamic inelastic material response. In particular, predicting total plastic deformation of a complex shipping container subjected to the rapid transient loads associated with a variety of severe accident conditions requires extensive computer time and places extreme demands on both software and the basic physical models underlying the analyses. The representation of dynamic inelastic materials response behavior in a form that is compatible with state-of-the-art computational methods and also accurately incorporates all of the features revealed in materials tests is thus of vital importance to the development of rational risk assessment. In an attempt to make maximum use of recent developments in continuum mechanics describing dynamic plastic material behavior, a program has been initiated at Argonne National Laboratory by the Transportation Branch of the DOE Division of Environmental Control Technology to assess the merits of endochronic plasticity in predicting the inelastic response of shipping containers designed for the transportation of hazardous materials. This paper reviews relevant details of the theory and discusses a recently developed finite-element program which has been modified to use an endochronic constitutive formulation.A series of sample problems for a variety of dynamic loadings are the basis for a preliminary evaluation of the theory in terms of its potential for saving computer time and its ability to accurately predict observed experimental behavior.

29456 (CONF-780506—(Vol.1), pp 437-446) **Experimental studies with lead-shielded scale model shipping containers.** Robinson, R.A.; Hadden, J.A. (Battelle Columbus Labs., OH). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

This paper presents results of preliminary dynamic impact experiments that were conducted with replica scale models of radioactive material shipping containers for assessment of potential safety and environmental consequences. One-eighth, 1/4, and 1/2 linear scale models were fabricated and tested to predict full-scale response of shipping containers employing unbonded lead shielding. Free fall impact experiments are discussed for plain cylindrical stainless steel shells, stainless steel shells filled with lead, and replica scale models of lead-shielded shipping containers. Also, a few standard dynamic and static experiments were conducted to determine the mechanical properties of the lead and other materials used to fabricate the models. The structural response of the models was studied for free fall impact onto an unyielding surface at various drop heights, angles to the impact surface, with and without impact limiters, and with different drop pad surface composition. The test temperature range examined was between -40 and 175°C. Appropriate scale modeling laws are developed in detail in Reference 5. These are substantiated for predicting full-scale response with 1/8, 1/4, and 1/2 linear scale models.

29457 **Leak rates of plutonia powder.** Yesso, J.D.; Madia, W.J.; Schmidt, E.W. (Battelle Columbus Labs., OH). *Trans. Am. Nucl. Soc.;* **33**: 189-190(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29458 **Extended testing of an approved shipping container for plutonium compounds.** Yoshimura, H.R. (Sandia Labs., Albuquerque, NM); Pope R.B.; Huebner, H.W.; Schulz-forberg, B. *Trans. Am. Nucl. Soc.;* **33**: 457-458(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29459 **Scale system cross-section validation with shipping-cask critical experiments.** Westfall, R.M.; Knight, J.R. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 368(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

TRANSPORT AND STORAGE FACILITIES

29460 **Sliding-gate valve.** Usnick, G.B.; Ward, G.T.; Blair, H.O.; Roberts, J.W.; Warner, T.N. (to Dept. of Energy). US Patent 4,174,728. 20 Nov 1979. Filed date 14 Nov 1977. 8p.

PAT-APPL-851,330.

This invention is a novel valve of the slidable-gate type. The valve is designed especially for long-term use with highly abrasive slurries. The sealing surfaces of the gate are shielded by the valve seats when the valve is fully open or closed, and the gate-to-seat clearance is swept with an inflowing purge gas while the gate is in transit. A preferred form of the valve includes an annular valve body containing an annular seat assembly defining a flow channel. The

seat assembly comprises a first seat ring which is slidably and sealably mounted in the body, and a second seat ring which is tightly fitted in the body. These rings cooperatively define an annular gap which, together with passages in the valve body, forms a guideway extending normal to the channel. A platetype gate is mounted for reciprocation in the guideway between positions where a portion of the plate closes the channel and where a circular aperture in the gate is in register with the channel. The valve casing includes opposed chambers which extend outwardly from the body along the axis of the guideway to accommodate the end portions of the gate. The chambers are sealed from atmosphere; when the gate is in transit, purge gas is admitted to the chambers and flows inwardly through the gate-to-seat-ring, clearance, minimizing buildup of process solids therein. A shaft reciprocated by an external actuator extends into one of the sealed chambers through a shaft seal and is coupled to an end of the gate. Means are provided for adjusting the clearance between the first seat ring and the gate while the valve is in service. 6 claims.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 28358

29461 Drill drive mechanism. Dressel, M.O. (to Dept. of Energy). US Patent 4,172,391. 30 Oct 1979. Filed date 9 Sep 1977. 8p.

PAT-APPL-831,727.

A drill drive mechanism is especially adapted to provide both rotational drive and axial feed for a drill of substantial diameter such as may be used for drilling holes for roof bolts in mine shafts. The drill shaft is made with a helical pattern of scroll-like projections on its surface for removal of cuttings. The drill drive mechanism includes a plurality of sprockets carrying two chains of drive links which are arranged to interlock around the drill shaft with each drive link having depressions which mate with the scroll-like projections. As the chain links move upwardly or downwardly the surfaces of the depressions in the links mate with the scroll projections to move the shaft axially. Tangs on the drive links mate with notch surfaces between scroll projections to provide a means for rotating the shaft. Projections on the drive links mate together at the center to hold the drive links tightly around the drill shaft. The entire chain drive mechanism is rotated around the drill shaft axis by means of a hydraulic motor and gear drive to cause rotation of the drill shaft. This gear drive also connects with a differential gearset which is interconnected with a second gear. A second motor is connected to the spider shaft of the different gearset to produce differential movement (speeds) at the output gears of the differential gearset. This differential in speed is utilized to drive said second gear at a speed different from the speed of said gear drive, this speed differential being utilized to drive said sprockets for axial movement of said drill shaft. 11 claims.

29462 Method for locating underground anomalies by diffraction of electromagnetic waves passing between spaced boreholes. Lytle, R.J.; Lager, D.L.; Laine, E.F.; Davis, D.T. (to Dept. of Energy). US Patent 4,161,687. 17 Jul 1979. Filed date 12 Sep 1977. 6p.

PAT-APPL-832,490.

Underground anomalies or discontinuities, such as holes, tunnels, and caverns, are located by lowering an electromagnetic signal transmitting antenna down one borehole and a receiving antenna down another, the ground to be surveyed for anomalies being situated between the boreholes. Electronic transmitting and receiving equipment associated with the antennas is activated and the antennas are lowered in unison at the same rate down their respective boreholes a plurality of times, each time with the receiving antenna at a different level with respect to the transmitting antenna. The transmitted electromagnetic waves diffract at each edge of an anomaly. This causes minimal signal reception at the receiving antenna. Triangulation of the straight lines between the antennas for the depths at which the signal minimums are detected precisely locates the anomaly. Alternatively, phase shifts of the transmitted waves may be detected to locate an anomaly, the phase shift being distinctive for the waves directed at the anomaly. 9 claims.

29463 Bulk material handling system. Kleysteuber, W.K.; Mayercheck, W.D. (to Dept. of Energy). US Patent 4,159,757. 3 Jul 1979. Filed date 4 May 1977. 8p.

PAT-APPL-793,664.

This disclosure relates to a bulk material handling system particularly adapted for underground mining and includes a monorail supported overhead which carries a plurality of conveyors each having input and output end portions with the output end portion of a first of the conveyors positioned above the input end portion of a second of the conveyors, a device for imparting motion to the conveyors to move the material from the input end portions toward the output end portions thereof, a device for supporting at least one of the input and output end portions of the first and second conveyors from the monorail, and the supporting device including a plurality of trolleys rollingly supported by the monorail whereby the conveyors can be readily moved therealong. 15 claims.

LASERS

REFER ALSO TO CITATION(S) 30006

29464 High energy XeBr electric discharge laser. Sze, R.C.; Scott, P.B. US Patent Application 028,778. [nd]. 7p.

A high energy XeBr laser for producing coherent radiation at 282 nm is disclosed. The XeBr laser utilizes an electric discharge as the excitation source to minimize formation of molecular ions thereby minimizing absorption of laser radiation by the active medium. Additionally, HBr, is used as the halogen donor which undergoes harpooning reactions with Xe/sub M/ to form XeBr.

29465 High energy KrCl electric discharge laser. Sze, R.C.; Scott, P.B. US Patent Application 028,740. [nd]. 6p.

A high energy KrCl laser is presented for producing coherent radiation at 222 nm. Output energies on the order of 100 mJ per pulse are produced utilizing a discharge excitation source to minimize formation of molecular ions, thereby minimizing absorption of laser radiation by the active medium. Additionally, HCl is used as a halogen donor which undergoes a harpooning reaction with metastable Kr/sub M/ to form KrCl.

29466 Laser beam alignment apparatus and method. Gruhn, C.R.; Hammond, R.B. US Patent Application 037,982. [nd]. 9p.

The disclosure related to an apparatus and method for laser beam alignment. Thermoelectric properties of a disc in a laser beam path are used to provide an indication of beam alignment and/or automatic laser alignment.

29467 (BNL—27598) **Three dimensional calculation of electron energy loss in a variable parameter free-electron laser.** Luccio, A.; Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract EY-76-C-02-0016. 30p. NTIS, PC A03/MF A01.

A single-pass free-electron laser (FEL) using a wiggler magnet with either the period, and/or the magnetic field, varying along the magnet axis has been proposed. The main advantage of this system over a conventional free-electron laser, having a constant period and magnetic field wiggler, is in the higher efficiency of the energy transfer from the electron beam to the laser radiation field. This efficiency, which is of the order of 1% in a conventional FEL, can be of the order of 30% in a variable wiggler FEL. The theory of the variable wiggler FEL is based on a one dimensional model, in which the electron motion transverse to the laser axis is assumed to be given and only the motion parallel to the axis is studied. In this paper, the effect on the laser efficiency of the electron transverse motion is studied and the electron energy loss is evaluated for a beam having a spread in angle and in the transverse position at the wiggler entrance. The complete three dimensional equations of motion for an electron interacting with the laser field and the wiggler field are integrated numerically. Only the case of a small gain regime, assuming that the laser field intensity remains constant, is considered. Also, this study is limited to the case of a helical wiggler. The results are compared with the one dimensional model. The effect of the initial position and angular spread can, to a good approximation, be considered equivalent to an increase in the energy spread. The limits for this increased energy spread that must not be exceeded in order to avoid a loss in efficiency are nearly the same as in the one dimensional model.

29468 (LA-UR—80-1427) **Excimer laser technology.** Mace, P.N. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800810—1). NTIS, PC A02/MF A01.

From 24. SPIE international symposium; San Diego, CA, USA (1 Aug 1980).

Scaling presently available excimer laser systems to lasers designed to operate at high average power and high pulse repetition rates for long periods of time requires advances in many areas of engineering technology. For economical application to industrial processes, the efficiency must be increased. This leads to more stringent requirements on preionization techniques, energy delivery systems, and system chemistry. Long life operation ($> 10^9$ to 10^{10} pulses) requires development of new pulse power components, optical elements and flow system components. A broad-based program underway at the Los Alamos Scientific Laboratory is addressing these key technology issues, with the help of advanced component and systems development programs in industry. A prototype XeCl laser meeting all requirements for efficiency, system performance and life is scheduled for completion in 1984.

29469 CF_4 laser. Wittig, C.; Tiee, J.J. (to Dept. of Energy). US Patent 4,176,326. 27 Nov 1979. Filed date 20 Oct 1977. 4p.

PAT-APPL-844,086.

A CF_4 laser is presented for producing near 16 μm radiation utilizing a line tunable CO_2 laser as an optical pumping source. The device uses a cryogenically cooled optically pumped cell containing molecular CF_4 gas. An optical resonant cavity formed around the optically pumped cell induces oscillations of near 16 μm radiation from the $\nu_2 + \nu_4 \rightarrow \nu_3$ transition in the molecular CF_4 gas. 8 claims.

29470 **Spatial elimination of side bands associated with acousto-optical pulse-picking.** Haugen, G.R. (Lawrence Livermore Lab., CA); Lytle, F.E. Contract W-7405-ENG-48. *Opt. Commun.;* **29**: No. 2, 204-208(May 1979).

Under certain conditions the leading and trailing members of an acoustically deflected train can be spatially separated from the intermediate pulses. This is shown to be a simple and useful experimental technique for temporally cleaning up the output of a pulse-picked, mode-locked laser or cavity-dumped cw laser. In addition a physical model is described that explains the phenomenon.

29471 **Buffer effects in nuclear-pumped XeF*(B).** Nagalingam, S.J.S.; Boody, F.P.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **33**: 81-82(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 28997, 29053, 29220, 29261

29472 **Numerical methods for hydraulic transients.** Leaf, G.K. (Argonne National Lab., IL); Chawla,T.C.; Minkowycz, W.J. *Numer. Heat Transfer;* **2**: 1-34(1979).

The finite-difference methods of Lax, Lax-Wendroff (two-step), and the donor cell type, and the finite-element method using a Galerkin procedure with B-splines as approximating functions are compared with the method of characteristics for the solution of waterhammer transients as typified by valve closure problems. From the point of view of accuracy, the two-step Lax-Wendroff method and the method of characteristics are comparable and produce the best results. The Lax method fares worst. The donor cell type and the Galerkin procedure with quandratic B-spline basis as approximating functions display roughly the same accuracy. From the comparison presented, it appears that Galerkin technique offers no substantial advantage over the other finite-difference mehtods except that of ease in hamdling boundary conditions as compared with finite-difference methods.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 29046, 29486, 29557

29473 **Apparatus for checking the direction of polarization of shear-wave ultrasonic transducers.** Karplus, H.H.B.; Forster, G.A. US Patent Application 003,559. [nd]. 11p.

An apparatus for checking the direction of polarization of shear-wave ultrasonic transducers comprises a first planar surface for mounting the shear-wave transducer, a second planar surface inclined at a predetermined angle to the first surface to generate longitudinal waves by mode conversion, and a third planar surface disposed at a second predetermined angle to the first for mounting a longitudinal-wave ultransonic transducer. In an alternate embodiment, two second planar surfaces at the predetermined angle are placed at an angle to each other. The magnitude of the shear wave is a function of the angle between the direction of polarization of the transducer and the mode-conversion surface.

29474 (RFP—2938) **Transducer characterization.** Cross, B.T.; Eoff, J.M.; Schuetz, L.J.; Cunningham, K.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 2 Jul 1980. Contract AC04-76DP03533. 16p. NTIS, PC A02/MF A01.

This report has been prepared specifically for ultrasonic transducer users within the Nondestructive Testing Evaluation (NDE) community of the weapons complex. The purpose of the report is to establish an initial set of uniform procedures for measuring and recording transducer performance data, and to establish a common foundation on which more comprehensive transducer performance evaluations may be added as future transducer performance criteria expands. Transducer parameters and the problems with measuring them are discussed and procedures for measuring transducer performance are recommended with special precautionary notes regarding critical aspects of each measurement. An important consideration regarding the recommended procedures is the cost of implementation. There are two distinct needs for transducer performance characterization in the complex. Production oriented users need a quick, reliable means to check a transducer to ascertain its suitability for continued service. Development groups and the Transducer Center need a comprehensive characterization means to collect adequate data to evaluate theoretical concepts or to build exact replacement transducers. The instrumentation, equipment, and procedures recommended for monitoring production transducers are utilitarian and provide only that information needed to determine transducer condition.

29475 (UCRL—52914) **Using the acoustoelastic effect to measure stress in plates.** Egle, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1980. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

A method for using longitudinal ultrasonic waves for measuring the sum of the principal stresses in welded plates is investigated. A cross-correlation technique for measuring the time delay between two successive echoes has been developed and shown to be capable of a precision of 10 ps. Stress measurements in a double cantilever beam and a disk-and-annulus specimen show good agreement with calculated values.

29476 (UCRL—52936) **TRAAP: a computer program for acquisition and analysis of data from a transient-measurement system.** Yanes, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

TRAAP is a computer program that records, analyzes, and plots data gathered by a transient recorder. It controls data acquisition by allowing the user to check the transient recorder before taking data and offering the choice of using or not using a low-pass filter. It transfers data to and from floppy disks for storage and playback. It analyzes data in a variety of ways (including compressing, smoothing, simple mathematical operations, differentiating, integrating) and provides four options for graphic output. TRAAP is a flexible program the capabilities of which can readily be increased; several new options are currently being developed. 9 figures.

29477 (UCRL—84046) **Holographic and acoustic emission evaluation of pressure vessels.** Boyd, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1980. Contract W-7405-ENG-48. 7p. (CONF-800804—5). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Optical holographic interfereometry and acoustic emission monitoring were simultaneously used to evaluate two small, high pressure vessels during pressurization. The techniques provide pressure vessel designers with both quantitative information such as displacement/strain measurements and qualitative information such as flaw detection. The data from the holographic interferograms were analyzed for strain profiles. The acoustic emission signals were monitored for crack growth and vessel quality.

29478 **Means for ultrasonic testing when material properties vary.** Beller, L.S. (to Dept. of Energy). US Patent 4,171,644. 23 Oct 1979. Filed date 28 Feb 1978. 6p.

PAT-APPL-882,025.

A device is provided for maintaining constant sensitivity in an ultrasonic testing device, despite varying attenuation due to the properties of the material being tested. The device includes a sensor transducer for transmitting and receiving a test signal and a monitor transducer positioned so as to received ultrasonic energy transmitted through the material to be tested. The received signal of the monitor transducer is utilized in analyzing data obtained from the sensor transducer. 3 claims.

29479 **Process for the detection of micro-cracks.** Lapinski, N.; Sather, A. (to Dept. of Energy). US Patent 4,172,224. 23 Oct 1979. Filed date 24 Oct 1978. 4p.

PAT-APPL-954,380.

A process is described for the nondestructive testing of ceramic objects to detect the presence of defects and microcracks in the surface in which a solution of silver nitrate is applied to the surface of the object which penetrates into the surface defects, drying the object so that the silver nitrate remains in the defects, and preparing an x-ray radiograph whereby any defects and microcracks will appear in the radiograph. 4 claims.

ELECTRONIC CIRCUITS AND DEVICES

29480 **Fiber optics welder.** Higgins, R.W.; Robichaud, R.E. US Patent Application 011,018. [nd]. 17p.

A system is described for welding fiber optic waveguides together. The ends of the two fibers to be joined together are accurately, collinearly aligned in a vertical orientation and subjected to a controlled, diffuse arc to effect welding and thermal conditioning. A front-surfaced mirror mounted at a 45° angle to the optical axis of a stereomicroscope mounted for viewing the junction of the ends provides two orthogonal views of the interface during the alignment operation.

29481 Communications system using a mirror kept in outer space by electromagnetic radiation pressure. US Patent Application 028,780. [nd]. 17p.

A communication system is disclosed which uses an electromagnetic energy reflector or mirror kept in outer space by electromagnetic radiation pressure. Using this system line-of-sight electromagnetic wave transmission could be provide to areas lacking line-of-sight broadcasting or ground relay stations without the use of earth orbiting satellites or long cables. In addition, the transmission system could cover large areas of the planet at a lower cost, using less power, and achieving higher efficiency than an earth orbiting satellite and do so without ionospheric interference of signal transmission.

29482 Isotropically sensitive optical filter employing atomic resonance transitions. Marling, J.B. US Patent Application 050,860. [nd]. 17p.

An ultra-high Q isotropically sensitive optical filter or optical detector is disclosed employing atomic resonance transitions. More specifically, atomic resonance transitions utilized in conjunction with two optical bandpass filters provide an optical detector having a wide field of view ($\sim 2\ \pi$ steradians) and very narrow acceptance bandwidth approaching 0.01A. A light signal to be detected is transmitted through an outer bandpass filter into a resonantly absorbing atomic vapor, the excited atomic vapor than providing a fluorescence signal at a different wavelength which is transmitted through an inner bandpass filters have no common transmission band, therby resulting in complete blockage of all optical signals that are not resonantly shifted in wavelength by the intervening atomic vapor. Two embodiments are disclosed, one in which the light signal raises atoms contained in the atomic vapor from the ground state to an excited state from which fluorescence occurs, and the other in which a pump laser is used to raise the atoms in the ground state to a first excited state from which the light signal then is resonantly absorbed, thereby raising the atoms to a second excited state from which fluorescence occurs. A specific application is described in which an optical detector according to the present invention can be located in an orbiting satellite.

29483 (BDX—613-2359) Automatic visual inspection of hybrid microcircuits. Hines, R.E. (Bendix Corp., Kansas City, MO (USA)). May 1980. Contract AC04-76DP00613. 98p. NTIS, PC A05/MF A01.

An automatic visual inspection system using a minicomputer and a video digitizer was developed for inspecting hybrid microcircuits (HMC) and thin-film networks (TFN). The system performed well in detecting missing components on HMCs and reduced the testing time for each HMC by 75%.

29484 (BDX—613-2403) Thermistor mount efficiency calibration. Cable, J.W. (Bendix Corp., Kansas City, MO (USA)). May 1980. Contract AC04-76DP00613. 84p. NTIS, PC A05/MF A01.

Thermistor mount efficiency calibration is accomplished by use of the power equation concept and by complex signal-ratio measurements. A comparison of thermistor mounts at microwave frequencies is made by mixing the reference and the reflected signals to produce a frequency at which the amplitude and phase difference may be readily measured.

29485 (BDX—613-2404) Power ratings of rf thin film resistive attenuators. Smith, F.R. (Bendix Corp., Kansas City, MO (USA)). Jun 1980. Contract AC04-76DP00613. 17p. NTIS, PC A02/MF A01.

Most radio frequency (rf) assemblies built using hybrid microcircuit technology employ thin film attenuators. These attenuators are subject to moderate rf peak power and to moderate average power. Because of intracircuit mismatch, extra considerations of power requirements must be given. To meet these requirements, selected thin film resistive attenuators operated under large rf power conditions were investigated, and the power margin in which these attenuators can be used was defined.

29486 (BDX—613-2424) Plated-through hole testing. Final repot. Abel, W.B. (Bendix Corp., Kansas City, MO (USA)). May 1980. Contract AC04-76DP00613. 55p. NTIS, PC A04/MF A01.

An improved microresistance testing method to measure the thickness of copper plating in plated-through holes of double-sided printed wiring boards is presented. A new probe design, combined with a microprocessor controller, makes it possible for a direct reading tester to provide variables data. Tester design and software programs for the system are included. Results of correlation studies, comparing the improved resistance method to cross-sectional measurements are presented. Limitations on the microresistance test method are discussed.

29487 (SAND—80-0969) Sandia LSI accelerated aging and data acquisition techniques. Walker, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

The purpose of the Microelectronic Evaluation Laboratory at Sandia is to develop a program for evaluating CMOS LSI (complementary metal oxide silicon - large scale integrated) technology devices which are being used for the first time in a weapon system. These evaluations are based on accelerated aging studies and electrical tests to determine the reliability and life of the devices. In accelerated aging, specific, controlled stresses are applied to the device to accelerate time-to-failure. Data are used tin mathematical models to estimate life in acutal use. The stresses used for this technology are temperature and voltage. The devices are stored at temperatures with or without voltage applied (steady-state or cyclical) and periodically tested until at least 50% failures are encountered. Since most current technologies use epoxy-die-attachment, aging temperatures must be under 200°C. This delays device failure, and a 16% failure level is used when this extrapolation is considered valid. Statistical analysis is performed on the resultant data to predict reliability with time. The equipment and procedures used for accelerated aging tests are described in detail. The data acquisition system and its use are discussed. All devices, after functional failure has occurred, are given to the failure analysis group for failure evaluations. In order to improve reliability predictions, failure analysis is most concerned with the separation of freak and main life mechanisms. Through these evaluations, higher reliability and longer device life have become a milestone of the future. (LCL)

29488 Proceedings of the 28th relay conference. Elkhart, IN; National Association of Relay Manufacturers (1980). 126p. (CONF-800494—).

From 28. relay conference; Stillwater, OK, USA (29 Apr 1980).

Fifteen papers presented at the 28th Annual National Relay Conference are included. The conference provided a forum for the open exchange of information between relay manufacturers and users and their mutual problems with the objective of improving the manufacturer's ability to supply reliable relays to meet the user's requirements and to help the user properly apply relays.

29489 Gaseous insulators for high voltage electrical equipment. Christophorou, L.G.; James, D.R.; Pace, M.O.; Pai, R.Y. (to Dept. of Energy). US Patent 4,175,048. 20 Nov 1979. Filed date 6 Sep 1977. 12p.

PAT-APPL-830,973.

Gaseous insulators comprise compounds having high attachment cross sections for electrons having energies in the 0 to 1.3 electron volt range. Multi-component gaseous insulators comprise compounds and mixtures having overall high electron attachment cross sections in the 0 to 1.3 electron volt range and moderating gases having high cross sections for inelastic interactions with electrons of energies 1 to 4 electron volts. Suitable electron attachment components include hexafluorobutyne, perfluorobutene-2, perfluorocyclobutane, perfluorodimethylcyclobutane, perfluorocyclohexene, perfluoromethylcyclohexane, hexafluorobutadiene, perfluoroheptene-1 and hexafluoroazomethane. Suitable moderating gases include N_2, CO, CO_2, and H_2. The gaseous insulating mixture can also contain SF_6, perfluoropropane and perfluorobenzene. 11 claims.

29490 Rf transformer. Smith, J.L.; Helenberg, H.W.; Kilsdonk, D.J. (to Dept. of Energy). US Patent 4,174,510. 13 Nov 1979. Filed date 28 Dec 1977. 6p.

PAT-APPL-865,162.

There is provided an improved rf transformer having a single-turn secondary of cylindrical shape and a coiled encapsulated primary contained within the secondary. The coil is tapered so that the narrowest separation between the primary and the secondary is at one end of the coil. The encapsulated primary is removable from the secondary so that a variety of different capacity primaries can be utilized with one secondary. 7 claims.

29491 High pressure electrical insulated feed thru connector. Oeschger, J.E.; Berkeland, J.E. (to Dept. of Energy). US Patent 4,174,145. 13 Nov 1979. Filed date 29 Dec 1976. 8p.

PAT-APPL-755,510.

A feed-thru type hermetic electrical connector is presented including at least one connector pin feeding through an insulator block within the metallic body of the connector shell. A compression stop arrangement coaxially disposed about the insulator body is brazed to the shell, and the shoulder on the insulator block bears against this top in a compression mode, the high pressure or internal connector being at the opposite end of the shell. Seals between the pin and an internal bore at the high pressure end of the insulator block and between the insulator block and the metallic shell at the high pressure end are hermetically brazed in place, the first of these also functioning to transfer the axial compressive load without permitting appreciable shear action between the pin and insulator block. 11 claims.

29492 **Step-control of electromechanical systems.** Lewis, R.N. (to Dept. of Energy). US Patent 4,169,283. 25 Sep 1979. Filed date 4 Apr 1977. 22p.
PAT-APPL-784,400.
The response of an automatic control system to a general input signal is improved by applying a test input signal and determining correctional constants necessary to provide a modified input signal to be added to the input to the system. A method is disclosed for determining correctional constants. The modified input signal, when applied in conjunction with an operating signal, provides a total system output exhibiting an improved response. This method is applicable to open-loop or closed-loop control systems. The method is also applicable to unstable systems, thus allowing controlled shutdown before dangerous or destructive response is achieved and to systems whose characteristics vary with time, thus resulting in improved adaptive systems. 15 claims.

29493 **Up-and-down chopper circuit.** Goffeau, J.R. (to Dept. of Energy). US Patent 4,161,023. 10 Jul 1979. Filed date 7 Sep 1977. 6p.
PAT-APPL-831-302.
An improved up-and-down chopper circuit is provided which is useful for voltage regulation in a bidirectional dc power system. In the down mode, power is switched from a dc power source to a lower voltage energy storing load while in the up mode stored energy in the load is transferred to the higher voltage source. The system uses Darlington transistor switches in a conventional connection. The improvement relates to circuit additions to eliminate the effects of inter-electrode capacitance inherent with this Darlington transistor switching arrangement. 3 claims.

29494 **Laser annealing of ion-implanted semiconductors.** White, C.W.; Narayan, J.; Young, R.T. (Oak Ridge National Lab., TN). *Science;* 204: No. 4392, 461-468(4 May 1979).
The physical and electrical properties of ion-implanted silicon annealed with high-powered laser radiation are described. Particular emphasis is placed on the comparison of materials properties that can be achieved with laser annealing to those which can be achieved by conventional thermal annealing. Applications of these techniques to the fabrication of high-efficiency solar cells, and potential applications of this new technique to other materials areas are discussed.

WASTE PROCESSING PLANTS AND EQUIPMENT

29495 (DOE/PE/70048—T1) **Evaluation of the ANFLOW process.** (JBF Scientific Corp., Wilmington, MA (USA)). May 1980. Contract AC01-79PE70048. 61p. NTIS, PC A04/MF A01.
The technical and economic feasibilty are examined of the ANFLOW process, an anaerobic process for removing suspended solids and oxygen-demanding organics from waste water by forcing the waste to flow upward through a column that contains a solid packing material supporting microorganisms. Bovine ruminant fluids are used to innoculate the columns with anaerobic microbes. The equipment and test procedures are described. These studies showed that the ANFLOW process meets standards for the secondary treatment of most municipal wastewaters with much less energy consumption (less than half) than activated sludge systems; methane is produced in this process but is expensive to recover; for plants with design flows of 1 mgd or less, ANFLOW systems appear to cost less than conventional systems; and the applicability of ANFLOW systems to large plant design flow must await future large-scale testing results. It was concluded that the ANFLOW process as compred with existing wastewater treatment systems is simple in design and operation, requires less land area, and conserves energy. (LCL)

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 28262, 28333, 28365, 28370, 28916

29496 (ANL/EES-TM—87) **Proceedings of the symposium on pulse combustion technology for heating applications.** Clinch, J.M. (comp.). (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 132p. (CONF-791187—). NTIS, PC A07/MF A01.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
Fifteen papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

29497 (ANL/EES-TM—87, pp 1-21) **Review of pulse-combustor technology.** Putnam, A.A. (Battelle-Columbus Labs., OH). May 1980.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
The scope of this paper is twofold. First, the results of a recent survey of workers in the field of pulse combustion (principally Russian) by Severyanin and Dereschcuk are reviewed. While the survey covered principally Russian investigators, a few other well-known investigators were also included. The survey indicated that thermal applications of pulse combustion appeared the most promising. Furthermore, the technology appears to be ready for the actual application of the phenomenon to practical devices. Second, in line with the indicated need to develop a variety of practical pulse-combustion devices, possible options in the different components of pulse-combustor systems are reviewed. The examples are based on component options that have been used in working pulse combustors.

29498 (ANL/EES-TM—87, pp 22-45) **Pressure-gain combustion, a review of recent progress.** Kentfield, J.A.C. (Univ. of Calgary, Alberta). May 1980.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
An ongoing, continuous program of work, commenced in 1966, directed at obtaining a fundamental understanding of pressure-gain combustion utilizing valveless pulsed-combustors is outlined. The ultimate aim of the work is to develop pulsed pressure-gain combustors suitable for a number of practical applications. This work is broken down into three categories: performance prediction, fundamental experimental work and applications orientated experiments. The description of the performance prediction work traces the development of a method-of-characteristics approach through three phases starting with hand-drawn wave diagrams and advancing, via a computerized cold-flow simulation of the pulsed pressure-gain combustor cycle, to a very recently developed hot flow computerized numerical model incorporating experimentally obtained heat-release rate data to assist in the representation of the combustion process. The fundamental experimental work carried out in connection with pulsed, pressure-gain combustion reviews is briefly described. Experiments designed to reveal the sensitivity of valveless pulsed combustors to small changes of geometry; the use of multiple inlets as an aid to reducing combustor length and increasing cyclic frequency; the rectification (catching and re-directing downstream) of the backflow from the inlets of valveless pulsed combustors; noise spectra; exhaust emissions; and the influence on specific performance of scaling-up from small size laboratory units are described.

29499 (ANL/EES-TM—87, pp 46-66) **Prediction of heat transfer in pulse-combustion burners.** Ahrens, F.W. (Argonne National Lab., IL). May 1980.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
One of the several attractive characteristics of pulse-combustion burners for heating applications is the augmentation in convective heat transfer that results from the pulsating flow of combustion products. Previous investigations have indicated that heat-transfer coefficients two or three times greater than steady-flow values (at the same mean flow rate) can be achieved in pulse-combustion devices if the proper configurations are employed. The goal of this work is the development of a procedure for predicting the influence of design parameters (combustion-chamber volume, exhaust-pipe length and diameter, input rate, etc.) on the thermal performance of pulse-combustion burners. When completed and validated with actual test data, such a procedure will aid in the design and development of heaters for specific applications. Because the intended use of the burner thermal model is for design-tradeoff (parametric) studies and overall-performance predictions, an attempt is being made to achieve the proper balance between simplicity, accuracy and ease of use. For example, the present heat-transfer model of the exhaust pipe is an extension (accounting for the finite combustion-chamber volume) of Hanby's simplified analysis. Refinements in the model will be introduced as needed to achieve reasonable agreement with future experimental results.

29500 (ANL/EES-TM—87, pp 67-70) **Pulsating combustors: modeling and applications.** Winiarski, L. May 1980.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
The computerized simulation of the operation and performance of pulsating combustors is discussed with emphasis on the development of mathematical models using basic conservation laws of mass, momentum, and energy. (LCL)

29501 (ANL/EES-TM—87, pp 71-94) **Modeling of the pulse-combustion process.** Edelman, R.B.; Turan, A.; France, D.H. (Science Applications, Inc., Canoga Park, CA). May 1980.
From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).
A hierarchy of models applicable to pulse combustors is described that can be used to aid in design and interpretation of data obtained from pulse-combustion systems. Hybrid models appear most promising at this time, and sufficient information now exists to

begin to apply these types of models, including fuel effects, to assist the development of pulse-combustor technology.

29502 (ANL/EES-TM—87, pp 95-104) **Combustion of captive coal particles in pulsating flow.** Lyman, F.A.; Sabnis, J.S. (Syracuse Univ., NY). May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

Experiments to determine the reduction in burning times of coal particles due to a pulsating flow of controlled frequency and amplitude are described. Previous work by other investigators on the combustion of particles and droplets in pulsating flow gave somewhat contradictory results, the reported reductions in burning times ranging from less than 30% to about 80%. In the present experiments, a pulsating flow of known amplitude and frequency is set up in the neck of a Helmholtz resonator. Burning of captive particles is monitored by a photomultiplier. Preliminary results obtained with this apparatus are described.

29503 (ANL/EES-TM—87, pp 129-143) **Combustion performance and noise emission characteristics of pulse combustion.** Chiu, H.H. (Univ. of Illinois, Chicago); Croke, E.J. May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

A pulsating-combustion model has been developed to examine the burning behavior and to assess the performance characteristics of pulse burners. Results of the analysis show that the spectra of the velocity and pressure pulsations exhibit broad-band and narrow-band oscillations at the firing frequency and its harmonics. The heat-transfer coefficient is found to increase in the axial direction of the tailpipe of the burner. These predicted results are in good qualitative agreement with the experimental results obtained by the ANL group. The scaling laws for the emitted noise and the heat-transfer coefficient are established and the law of the correlation of these two properties with the non-steady heat release is obtained. A methodology pertaining to the optimization of burner performance is described.

29504 (ANL/EES-TM—87, pp 144-162) **Experimental gas-fired pulse combustion burner.** Clinch, J.M.; Egbert, H.P. Jr. (Argonne National Lab., IL). May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

The design, construction, and instrumentation of an experimental water-cooled gas-fired pulse-combustion burner are described. The nominal gas-input rate to the burner is 150,000 Btu/hr. The burner system has been designed for experimental versatility. For example, changes in the combustion-chamber and tailpipe lengths can be readily assessed. Also the valves, which are of the mechanical flapper type, have continuously adjustable lifts to permit changes in air/fuel ratio and total gas input to be studied. Individual cooling-water-channel segments are positioned around the combustion-chamber wall and tailpipe to determine local heat flux from monitoring temperatures and water flow rates. A minicomputer data-acquisition control system has been assembled to control, log, store, and compute a large number of measured variables. The system is designed to interface with 150 thermocouples, 15 pressure transducers, 5 flow meters, and 54 control solenoids. As a controller, the minicomputer selects and controls the solenoid valves to measure the heat transferred to each of the 54 water-cooling channels surrounding the burner wall. The data-acquisition system permits well-controlled experimental data to be rapidly obtained to determine the combustor performance for a wide range of burner parameters and operating conditions. For example, the sensitivity of heat-transfer performance and noise to changes in air/fuel ratio and combustor geometry can be readily assessed.In addition to the gas-fired burner system, experiments are being planned for extending the pulse-combustion concept to liquid- and solid-fuel-burning systems.

29505 (ANL/EES-TM—87, pp 163-166) **Canadian development of pulse-combustion heating equipment.** Kitchen, J.A. May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

Canadian development of gas-fired forced-air pulse combustion furnaces fueled with either natural gas or propane is discussed. This development commencing in late 1956, included design, fabrication, and performance testing. A 100,000 Btu model from this development was redesigned in 1976 and is being produced in New Jersey. A warm air furnace with an efficiency of 95% and an exhaust temperature of about 100°F is currently under development. (LCL)

29506 (ANL/EES-TM—87, pp 167-180) **R and D and other needs for exploitation of pulse combustion in space-heating applications.** Belles, F.E. May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

The need to utilize gas more efficiently has focused attention on pulse combustion as a promising technology for application to space heating. Using the development of a prototype forced-air pulse-combustion furnace as a framework for discussion, information gaps that need to be filled in order to exploit this technology effectively are identified.

29507 (ANL/EES-TM—87, pp 190-223) **Fuel and cost efficiency of combustion systems with low off-period losses.** Bonne, U.; Patani, A. May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

Since it became clear that seasonal system efficiencies of conventional combustion heating equipment are typically 10 to 15% (gas) to 5 to 10% (oil) lower than steady-state efficiencies, the role of off-period losses has been explored in relation to: making system efficiencies equal to or higher than steady-state values; determining the influence of heat-exchanger thermal mass or flue-temperature profile on system efficiency; and defining the dependence between cycling rate, load (sizing), and system efficiency. A comparative analysis of how the above performance features are determined by stack dampers, power (induced or forced-draft) burners, and pulse combustion was made with the help of the HFLAME simulation model, backed up by experimental data. Results of this study are presented. Highlights are as follows: low off-period loss systems (LOPLS) can achieve average on-period efficiencies that are above steady state values; while more cycles/h and higher-thermal-mass heat exchangers result in lower system efficiences with conventional systems (atm. burner and standing pilot), the opposite is true with LOPLS; increasing oversize of LOPLS results in higher seasonal system efficiencies; system efficiency is not affected by the shape of the flue-temperature profile, provided a certain symmetry and off-period leakage are conserved; and direct outdoor air lowers efficiency. Some performance features that are unique to pulse-combustion systems are also discussed; e.g., prepurging was found to reduce system efficiency by less than 1%.

29508 (ANL/EES-TM—87, pp 224-238) **Drying food and wastes with pulsating combustion.** Lockwood, R.M. (Jetsonic Processes, Palo Alto, CA). May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

Pulsating combustion, by its very nature, can provide great benefits from improved heat transfer and mass transfer if coupled with properly designed drying systems called Jetsonic. The acoustic waves (noise) that result from pulsating combustion provide the mechanism of ultra-high heat and mass transfer. These broad-band sonic waves are composed of compression waves closely coupled with rarefaction waves. The net result is very efficient and rapid removal of the moisture-laden boundary layer surrounding each drying particle, resulting in drying rates as much as ten times faster than with conventional drying systems. The extreme mechanical simplicity of the resonant pulsating-combustion devices represents a further economic advantage. Valveless pulsejets are ideal for these applications, when coupled with tuned jet pumps. The resultant system converts the potential energy in fuels into heat for processing, broad-band sonics and pumping of process gases with compact jet pumps. The high-performance pulsating jet pumps were conceived and developed for aircraft and other military thrust-augmentation uses, resulting in augmentation as great as 150% of the primary jet thrust and with compact, lightweight hardware that easily achieved thrust-to-weight ratios as high as 12/1. These thrust augmentors are used in drying systems as highly efficient jet pumps in the Jetsonic Heater-Blower systems, which have no moving mechanical parts.

29509 (ANL/EES-TM—87, pp 239-246) **Application of pulsating combustion in the burning of solid fuels.** Zinn, B.T.; Daniel, B.R.; Sheshardi, T.S. (Georgia Inst. of Tech., Atlanta). May 1980.

From Symposium on pulse combustion technology for heating applications; Argonne, IL, USA (29 Nov 1979).

The scope of a research program that was recently initiated under DOE support is described. This research program is concerned with the development of a coal-burning pulsating combustor for use in steam raising and related industrial applications. The proposed first-year research program will be primarily concerned with the development of a coal-burning pulsating combustor and the evaluation of its operating characteristics. Special emphasis will be given to the determination of the combustor design features that will result in optimum combustor performance. The proposed combustor design will be based upon recent work in the Soviet Union that utilized the principles of the Rijke tube in the successful development of a coal-burning pulsating combustor. Advantages of such combustors, reported in the Russian literature, include improved combustion intensity; improved heat-transfer characteristics; reduced NO/sub x/, smoke, and slag formation; effective cleaning of heat transfer surfaces by acoustic motion; self aspiration of the oxidizer flow that eliminates the need for a fan or a blower for forcing the air through the combustor; and a capability for burning unpulverized coal. The first year of investigation is expected to yield a general evaluation of the characteristics of coal-burning pulsating combustors, and follow-up research will be concerned with detailed under-

standing of the various processes (such as unsteady combustion and heat transfer) that affect the operation of pulsating combustors and the development of a rational design procedure for these devices.

29510 (DOE/ET/10379—48) **Industrial application fluidized bed combustion. Category III: indirect fired heaters. Quarterly technical report No. 15, January 1-March 31, 1980.** (Exxon Research and Engineering Co., Florham Park, NJ (USA). Engineering Technology Dept.). 1980. Contract AC01-76ET10379. 46p. NTIS, PC A03/MF A01.

A Process Stream Coking Test Unit has been used to study the parameters affecting coke laydown on the internal surfaces of hydrocarbon containing tubes under conditions of high termperature and heat transfer rate. The data analysis shows that in addition to film temperature, mass velocity is an important parameter in controling coking rate. No coke laydown occurred in any tests run at a mass velocity of 600 lb/sec ft^2 at heat fluxes up to 60,000 Btu/hr ft^2. The High Temperature Heat Flux Test Unit was put into operation. The first series of tests using propane as the fuel have been completed. Additional tests are now being run using coal fuel. The object of the Economic and Applications Task of the Program is to evaluate the economic and logistic factors that might influence the schedule and circumstances under which coal fired Atmospheric Fluidized Bed Combustion (AFBC) technology might be applied to petroleum and petrochemical plant process heaters. The task has been divided into two phases. The first phase, the Applications Phase, has been completed. The results indicate that the potential for near term application of AFBC technology to refinery crude heaters is relatively low. Alternative applications are now being screened. The preliminary design of one alternative FBC process unit is described. The final task of the program will be to prepare a design specification for a hypothetical commercial sized process heater from which all interested parties can make a definitive evaluation of the technical and commercial prospects of the technology.

29511 (DOE/ET/13152—2) **Measuring and modeling solids movement in a large, cold fluidized bed test facility. Second quarterly report, January 1, 1980-March 31, 1980.** Fitzgerald, T.J.; Mrazek, R.V.; Crane, S.D. (Oregon State Univ., Corvallis (USA). Dept. of Chemical Engineering). Mar 1980. Contract AC01-79ET13152. 84p. NTIS, PC A05/MF A01.

Movies taken of the sand/freon system vs. the cork/air system in two bed configurations (rectangular and cylindrical) and tungsten carbide/water vs. expanded polystyrene/air in a cylindrical bed configuration at U/sub mf/ and various multiples of U/sub mf/ showed similarities in bubble growth and solids flow patterns. In addition, in the slugging beds the slugs appear to be nearly equal in scaled length, they rise to the same scaled height, and they rise at nearly the same scaled velocity. The ratios of the average frequency of pressure fluctuations for the cork/air vs. sand/freon system in the rectangular bed configuration were near the predicted value of 2.92. The results strongly indicate that the four dimensionless groups can be used for scaling cold models. That is, the performance of one cold model can be used, reliably, to predict the performance of an exactly scaled second model even in extreme cases (i.e. tungsten/water vs. expanded polystyrene/air). It therefore seems likely that the fluidization hydrodynamics of a hot fluidized bed can be modeled in a scaled cold bed using the same dimensionless groups.

29512 (EPRI-CS—1426) **Preliminary design and assessment of circulating-bed boilers. Final report.** Fraley, L.D.; Hsiao, K.H.; Do, L.N. (Pullman Kellogg, Houston, TX (USA)). Jun 1980. 200p. NTIS, PC A09/MF A01.

The circulating bed boiler (CBB) represents an alternative, fluidized bed combustor (FBC) technology which offers distinct advantages over both the current FBC systems, and pulverized-coal boilers with scrubbers. This report describes the findings of a study undertaken to evaluate these advantages. The information obtained made it possible to identify potential CBB design and operating problems and to propose further plans for developing this technology. Several significant determinations resulted from the study. The circulating bed boiler capital costs should not exceed the cost for a conventional atmospheric fluid bed combustor, primarily due to the reduced combustor size; however, any cost advantage for a pressurized circulating bed boiler is questionable. Overall efficiency for an electric utility power plant using an atmospheric CBB should be increased by at least 1% over using a pulverized-coal boiler and the increase would be at least 3% using a pressurized CBB. The circulating bed boiler has several of the advantages of an FBC over pulverized coal, and in addition, it has turndown capabilities, greater throughput, and simplified feeding. Both the atmospheric and the pressurized CBB's can be designed with technology currently available in the process industry, but only after additional study and development has been completed for cyclones, pollution control, solids attrition, feed systems, and combustion reactions. Pilot plant studies are required for these investigations.

29513 (GFETC/IC—79/1, pp 75-107) **Low-rank coal atmospheric fluidized-bed combustion technology.** Goblirsch, G.M.; Sondreal, E.A. (Department of Energy, Grand Forks, ND). 1979.

From 10. biennial lignite symposium; Grand Forks, ND, USA (30 May 1979).

The history and advantages of atmospheric fluidized-bed combustion (AFBC) are reviewed. The AFBC process and the experimental facilities at the Morgantown Energy Technology Center, Fluidyne Corporation, Combustion Power Company, Inc., and the Grand Forks Energy Technology Center are described. A summary is made of available process data for Western and Gulf Coast lignite and for subbituminous coal with special attention given to sulfur retention and nitrogen oxides emissions. The most important factor in determination of sulfur retention is the molar ratio of total alkali to coal sulfur. Principal operating variables affecting sulfur retention are bed temperature, superficial gas velocity, and air-to-fuel ratio. Using only the inherent ash alkali in a North Dakota lignite, approximately 50% of the sulfur is retained without and about 60% with ash reinjection. Over 90% sulfur retention could be achieved by addition of alkali to give a alkali/sulfur ratio of 2.6. Conditions of bed temperature less than 1400°F and of excess air less than 30% are necessary to maintain NO/sub x/ emissions below 0.5 lb/10^6 Btu. Combustion efficiencies using low-rank coals range from 92 to 96%. When burning a high sodium lignite, agglomeration of bed particles and deposition on surfaces may pose an operational problem.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 28661, 28662, 28663, 28665, 28666, 28673

29514 **Numerical calculation of wave forces of structures.** Nichols, B.D.; Hirt, C.W. (Los Alamos Scientific Lab., NM). pp 2254-2270 of Fifteenth coastal engineering conference. New York, NY; American Society of Civil Engineers (1977).

From 15. conference on coastal engineering; Honolulu, HI, USA (11 Jul 1976).

A finite-difference technique for solving the Navier-Stokes equations for an incompressible fluid is used to calculate transient wave forces experienced by fixed and moving bodies. The numerical technique is based on the Marker-and-Cell (MAC) method developed by Harlow and Welch (1965). This new technique uses an especially simple solution algorithm that is designed for persons with little or no experience in numerical fluid dynamics. Originally conceived as an instructional tool, it has proven to be an extremely useful and versatile calculational method. Many useful calculations are possible with the publicly available code, SOLA-SURF, which is briefly described; however, the outstanding feature of this numerical scheme is the ease with which it can be modified to handle more complex problems. Reported here are examples to illustrate the utility of this new calculational tool for investigating the dynamic interactions between ocean waves and coastal structures.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 28927, 29173, 29629

PARTICLE ACCELERATORS

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 29976

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 29982, 29983

29515 **Beginning.** Livingood, J.J. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 4-9(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The activites of the numerous physicists involved in the decision to construct the ZGS are briefly reviewed. (AIP)

29516 **ZGS - conception to turn-on.** Teng, L.C. (Fermi National Accelerator Laboratory, Batavia, IL 60515). *AIP Conf. Proc.;* **60**: No. 1, 10-17(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

A concise review of the many policy decisions that were made in the design of the ZGS is given. (AIP)

29517 Peak years. Cork, B. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *AIP Conf. Proc.;* **60**: No. 1, 40-52(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The facilities available at ZGS and some of the experiments performed there since 1968 are described. (AIP)

29518 External proton beams and the proton-proton experiments. Ratner, L.G. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 90-100(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The ZGS was one of the first accelerators in which extracted primary proton beams and experimental halls were part of the initial design. Special features incorporated into the ring made it possible to permanently position extraction magnets, and there was no need to plunge them as in other machines.

29519 ZGS as seen from the midnight shift. Bacci, F.F. (Argonne National Laboratory, Argonne, Ilinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 170-172(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The early operations of the ZGS are recounted by an Assistant Chief of Operations. (AIP)

29520 Experimental area operations. Bouie, R. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 178-180(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The role of the Experimental Area Manager at the ZGS is discussed. (AIP)

29521 Technician's view of high energy physics. Prien, R.J. (Argonne National Laboratory, Argonne Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 190-191(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The diverse function of technicians from 22 different divisions are remarked upon. (AIP)

29522 Zero gradient synchrotron (ZGS) operations - the vintage years. Potts, C.W. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 192-197(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The ZGS operating efficiency, system reliability, and beam intensity are considered. (AIP)

29523 History of the superconducting magnet bubble chambers. Derrick, M.; Hyman, L.G.; Pewitt, E.G. (Argonne National Laboratory). *AIP Conf. Proc.;* **60**: No. 1, 198-226(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

A summary of the many experiments performed at the ANL bubble chamber is given. (AIP)

29524 Non-HEP programs at the ZGS - past, present and future. Martin, R.L. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 227-241(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

Some miscellaneous ZGS experiments are reviewed including ocean thermal energy conversion, solar collectors, proton radiography, and heavy ion fusion. (AIP)

29525 Visual reminiscences of the ZGS. Jovanovic, D.D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *AIP Conf. Proc.;* **60**: No. 1, 242-268(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

A photographic history of the construction and operation of the ZGS is presented. (AIP)

29526 ZGS history as seen from Washington. Wallenmeyer, W.A. (U. S. Department of Energy, Washington, DC). *AIP Conf. Proc.;* **60**: No. 1, 290-302(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The development of the ZGS is described from the point of view of DOE.(AIP)

29527 Highlights and speculations. Fields, T.H. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 303-313(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

Several examples of unfinished business of the ZGS program are described. These examples cover physics, apparatus, and institutional subjects. Speculations are given about the evolution of these subjects during the 1980's.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 29542

AUXILIARIES AND COMPONENTS

ION SOURCES

29528 (LA-UR—80-1724) Improvements in the LAMPF Lamb-shift polarized source. Chamberlin, E.P.; York, R.L.; Williams, H.E.; Rios, E.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—6). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

Modifications which have improved the intensity and reliability of the LAMPF polarized ion source are discussed.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 29517, 29791

29529 (LBL—9961) New sources of radiation. Schimmerling, W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01.

An attempt is made to select examples of radiation sources whose application may make new or unconventional demands on radiation protection and dosimetry. A substantial body of knowledge about high energy facilities exists and, partly for this reason, the great high energy accelerators are mentioned only briefly.

29530 (LBL—11007) Progress on the superconducting magnet for the time projection chamber experiment (TPC) at PEP. Green, M.A.; Eberhard, P.H.; Burns, W.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 24p. (CONF-800684—1). NTIS, PC A02/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

The TPC (Time Projection Chamber) experiment at PEP will have a two meter inside diameter superconducting magnet which creatests a 1.5 T uniform solenoidal field for the TPC. The superconducting magnet coil, cryostat, cooling system, and the TPC gas pressure vessel (which operatests at 11 atm) were designed to be about two thirds of a radiation length thick. As a result, a high current density coil design was chosen. The magnet is cooled by forced flow two phase helium. The TPC magnet is the largest adiabatically stable superconducting magnet built to date. The paper presents the parameters of the TPC thin solenoid and its subsystems. Tests results from the Spring 198ȯ cryogenic tes are presented. The topics to be dealt with in the paper are cryogenic services and the tests of magnet subsystems such as the folded current leads. Large thin superconducting magnet technology will be important to large detectors to be used on LEP.

29531 (PUB—300(Vol.4)(No.5)) Research/Accelerators. Bimonthly status report of operations, September-October 1979. Knight, J.W. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01.

Research activities during September and October 1979 are discussed. Areas covered include: publications and presentations on accelerators, nuclear science, physics, applied mathematics and computer science; accelerator operations in the Bevatron/Bevalac, SuperHILAC, 88-inch Cyclotron, and 184-inch Cyclotron; and progress on the PEP storage rings. (GHT)

29532 (SAND—80-0456C) Low jitter spark gap switch for repetitively pulsed parallel capacitor banks. Rohwein, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-800640—2). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

A two-section air insulated spark gap has been developed for switching multi-kilojoule plus-minus charged parallel capacitor banks which operate continuously at pulse rates up to 20 pps. The switch operates with less than 2 ns jitter, recovers its dielectric strength within 2 to 5 ms and has not shown degraded performance in sequential test runs totaling over a million shots. Its estimated life with copper electrodes is $> 10^7$ shots. All preliminary tests indicate that the switch is suitable for continuous running multi-kilojoule systems operating to at least 20 pps.

29533 (SAND—80-0460C) **Measurement of fast risetime megampere currents by quartz gauge.** Williams, R.R.; McDaniel, D.H.; Stinnett, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 4p. (CONF-800640—6). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

Quartz gauges have been used on the Sandia National Laboratories Proto II accelerator to measure current in the magnetically insulated transmission line at the 11 TW power level. The accelerator delivers 3.5 MA at 2 x 10^{14} A/s in a 40 ns pulse to a 0.0127 m diameter aluminum liner to produce a high density plasma. At this radius and dI/dt levels, the B-dot monitors no longer function for the measurement of load current because the monitor suffers electrical breakdown. Quartz pressure gauges mounted at a radius of 0.0086 m have successfully measured the magnetic pressure due to the load current with nanosecond temporal resolution.

29534 (SAND—80-0491C) **Development of a 50 Hz, 250 kV, 500 ns, 500 KW average power pulser.** Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 6p. (CONF-800640—8). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

This paper describes the development of a 50 Hz research pulser with per shot specifications of 250 kV, 500 ns FWHM, 10 kJ. It is designed for burst mode service. The pulser is a two element Guillemin Type C pulse forming network with two parallel Marx generators serving as the first element and a single Marx generator serving as the second element. This paper will consider the two Marx generators of the first element only and will outline the important ongoing developmental areas.

29535 (SAND—80-1241C) **Simulation of power flow in magnetically insulated convolutes for pulsed modular accelerators.** Seidel, D.B.; Goplen, B.C.; VanDevender, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 16p. (CONF-800640—9). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

Two distinct simulation approaches for magnetic insulation are developed which can be used to address the question of nonsimultaneity. First, a two-dimensional model for a two-module system is simulated using a fully electromagnetic, two-dimensional, time-dependent particle code. Next, a nonlinear equivalent circuit approach is used to compare with the direct simulation for the two module case. The latter approach is then extended to a more interesting three-dimensional geometry with several MITL modules.

29536 (UCID—18642) **Experimental test accelerator: description and results of initial experiments.** Fessenden, T.; Birx, D.; Briggs, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jun 1980. Contract W-7405-ENG-48. 82p. NTIS, PC A05/MF A01.

The ETA is a high current (10,000 Amp) linear induction accelerator that produces short (30 ns) pulses of electrons at 5 MeV twice per second or in bursts of 5 pulses separated by as little as one millisecond. At this time the machine has operated at 65% of its design current and 90% of the design voltage. This report contains a description of the accelerator and its diagnostics; the results of the initial year of operation; a comparison of design codes with experiments on beam transport; and a discussion of some of the special problems and their status.

29537 (UCRL—83912) **FXR one-nanosecond-jitter switch.** McFarlane, H.B.; Kihara, R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 4p. (CONF-800640—15). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

A switching system using low-jitter spark gaps has been designed for a 20 MeV Flash X-Ray (FXR) linear induction accelerator that is being built at the Lawrence Livermore National Laboratory. The accelerator, which is now under construction, will consist of 54 modules connected in tandem. Each module will contribute up to 400 keV of energy to the electron beam traversing it. The experimental work included a test of one accelerator module designed to produce 400 keV. Of particular concern was the thorough characterization of the Blumlein switch in terms of lifetime, voltage hold off and operating pressure range to produce minimal jitter and an acceptably low prefire rate. The data was recorded by means of a computer-based data-acquisition system which was set up for later, automatic data reduction and display fo the results. Optimization of the spark gap operating parameters resulted in a firing jitter of less than one nanosecond rms.

29538 (UCRL—83970) **Computer models in the design of FXR.** Vogtlin, G.; Kuenning, R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 16p. (CONF-800640—14). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

Lawrence Livermore National Laboratory is developing a 15 to 20 MeV electron accelerator with a beam current goal of 4 kA. This accelerator will be used for flash radiography and has a requirement of high reliability. Components being developed include spark gaps, Marx generators, water Blumleins and oil insulation systems. A SCEPTRE model was developed that takes into consideration the non-linearity of the ferrite and the time dependency of the emission from a field emitter cathode. This model was used to predict an optimum charge time to obtain maximum magnetic flux change from the ferrite. This model and its application will be discussed. JASON was used extensively to determine optimum locations and shapes of supports and insulators. It was also used to determine stress within bubbles adjacent to walls in oil. Computer results will be shown and bubble breakdown will be related to bubble size.

29539 (UCRL—84013) **Switching system for the FXR accelerator.** Scarpetti, R.D.; Parkinson, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 13p. (CONF-800640—16). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

A switching system has been designed for a 20 MeV flash x-ray linear induction accelerator which is being built at Lawrence Livermore Laboratory. The switching system fans out a single command pulse and amplifies it to obtain the voltage necessary for reliable, low-jitter triggering of the accelerator components. This system consists of two major subsystems: (1) the Blumlein Charging Subsystem which first triggers thirteen Marx generators, and then charges 54 water-filled Blumleins, and (2) the Blumlein Triggering Subsystem which triggers the already-charged Blumleins to produce a 90 nanosecond, 400 kV pulse in each of 54 ferrite-loaded accelerator modules. The first subsystem consists of charged high voltage cabling with two parallel switch gaps either of which will trigger the Marx generators. The major components of the second subsystem are three stages of switch gaps along with the necessary high voltage cabling. Two parallel first stage switch gaps trigger thirteen second stage gaps, which in turn trigger 54 third stage Blumlein switch gaps synchronous with the passage of the electron beam pulse. These spark gaps are operated at a voltage of 150 to 350 kV with a 1/3 hertz repetition rate. Varying the cable lengths creates the actual delay times in the triggering of each component. Redundancy is built into the system to insure the high reliability which is essential for the flash radiography application.

29540 **Making targets for a new heavy ion facility.** Thomas, G.E.; den Hartog, P.K.; Yntema, J.L.; McKeown, R.D. (Argonne National Lab., IL (USA)). *Nucl. Instrum. Methods;* **167**: No. 1, 29-31(Dec 1979).

From 7. annual meeting of the International Nuclear Target Development Society; Garching, Germany, F.R. (11 - 14 Sep 1978).

The superconducting linac now being built and tested at the Argonne National Laboratory and to be used with the FN Tandem has as its objective to provide precision beams of heavy ions for physics research. Providing stripper foils having reasonable lifetimes for the linac as well as for the Tandem when using heavy ions is a necessity. We have shown that either heating or rotating the foils or a combination of both increases their lifetime. We now find that the lifetime can be significantly increased by high speed rotation of a disc containing the foils. Techniques have also been developed to increase the lifetime of targets used in experiments having intense beams and which may be applicable to heavy ion physics. These techniques involve principles of conductivity, radiation, and target rotation.

29541 **Preparation and characterization of radioactive samples for various areas of research.** Adair, H.L. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Nucl. Instrum. Methods;* **167**: No. 1, 45-53(Dec 1979).

From 7. annual meeting of the International Nuclear Target Development Society; Garching, Germany, F.R. (11 - 14 Sep 1978).

The Isotope Research Materials Laboratory (IRML) at the Oak Ridge National Laboratory (ORNL) prepares many radioactive targets to meet a myriad of experimental requirements. In general, most of the targets are either actinide or tritium deposits and are

used for precision cross-section measurements, neutron dosimetry, material property measurements, compatibility studies or for the generation of neutrons. The materials have to be accurately characterized as to content and uniformity. The techniques used by IRML to prepare actinide oxide deposits and metals of plutonium, americium, and curium, will be reviewed. The IRML neutron dosimeter program, including types of materials, encapsulation and characterization procedures will be described in depth. The systems to be used in fabricating 50 cm diameter tritium targets in support of fusion reactor materials research will be described.

STORAGE RINGS

29542 (BNL—27975) **Lectures in accelerator theory.** Month, M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 53p. NTIS, PC A04/MF A01.

Lecture I deals with the behavior of particles in the nonlinear field arising from the electromagnetic interaction of colliding beams. The case treated, that of counter-rotating proton beams crossing each other at a non-zero angle, has the simple feature that the force between the beam is one dimensional. In lecture II, an analysis of the development of traveling waves on particle beams is presented. The situation studied is that of a uniform beam current in a circular accelerator and the excitation for the coherent motion is induced by the resistivity of the vacuum chamber wall. Finally, in lecture III, a description of the current accumulation process used at the proton storage rings at CERN (The ISR) is given. Particle pulses of rather low average current are injected and stored along the length and width of the vacuum chamber. The efficiency is very high and large currents (over 40 amperes) have been achieved.

29543 (BNL—28019) **Proton-proton colliding beam facility ISABELLE.** Hahn, H. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 12p. (CONF-800740—1). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

This paper attempts to present the status of the ISABELLE construction project, which has the objective of building a 400 + 400 GeV proton colliding beam facility. The major technical features of the superconducting accelerators with their projected performance are described. Progress made so far, difficulties encountered, and the program until completion in 1986 is briefly reviewed.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 29056, 29617

29544 **Cadmium telluride photovoltaic radiation detector.** Agouridis, D.C.; Fox, R.J. US Patent Application 078,759. [nd]. 12p.

A dosimetry-type radiation detector is provided which employs a polycrystalline, chlorine-compensated cadmium telluride wafer fabricated to operate as a photovoltaic current generator used as the basic detecting element. A photovoltaic junction is formed in the wafer by painting one face of the cadmium telluride wafer with an n-type semi-conductive material. The opposite face of the wafer is painted with an electrically conductive material to serve as a current collector. The detector is mounted in a hermetically sealed vacuum containment. The detector is operated in a photovoltaic mode (zero bias) while DC coupled to a symmetrical differential current amplifier having a very low input impedance. The amplifier converts the current signal generated by radiation impinging upon the barrier surface face of the wafer to a voltage which is supplied to a voltmeter calibrated to read quantitatively the level of radiation incident upon the detecting wafer.

29545 (LA-UR—80-1361) **Repetitive MEGAMP per microsecond di/dt pulsers for driving sub-ohm transmission line neutrino particle detectors.** Krausse, G.J.;; Dalton, C.G.; Sarjeant, J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800640—4). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

With the advent of low-cost honeycomb extrusions of polypropylene sheets, transmission line flash chambers have become highly attractive candidates for large particle detector arrays. This has brought about the need for repetitive pulse systems that must provide exceptionally high peak currents, low levels of spurious radiation, high reliability, and shot life in excess of 10^7. Each module of 10 flash chambers requires a peak current of 20 kA with a current di/dt greater than 1 MA/μs. The pulser output must develop ≈ 7 kV across a load of 0.5 Ω with a pulse width of 500 ns. The complete system will require 40 pulsers run in parallel for a combined current output of 1.4 MA peak with a system di/dt of 40 MA/μs. The repetition rate will be up to 2 Hz. This paper describes the development of such a system, its unique voltage and current diagnostics, and the impact of the physical limitations of present component technology on lifetime, reliability, maintainability, and pulse fidelity.

29546 (LBL—10547) **Photomultiplier characteristics considerations for the deep underwater muon and neutrino detection system.** Leskovar, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 23 Feb 1980. Contract W-7405-ENG-48. 23p. (CONF-800240—2). NTIS, PC A02/MF A01.

From Deep underwater muon and neutrino detection signal processing workshop; Honolulu, HI, USA (11 Feb 1980).

The results of an investigation of the characteristics of photomultipliers for the Deep Underwater Muon and Neutrino Detection (DUMAND) System are discussed. The pulse-height resolution, the afterpulsing phenomena and the gain sensitivity to the ambient magnetic field have been determined for large photocathode area photomultipliers. Furthermore, the transient time difference, the single photoelectron time spread, and the collection and photocathode quantum efficiency uniformity as a function of the position of the photocathode sensing area have been reviewed. Finally, an attempt has been made to estimate the photomultiplier reliability and its lifetime.

29547 **Application of bismuth germanate scintillators to detection of high-energy gamma radiation.** Evans, A.E. Jr. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 693-696(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29548 **Analytic approach to performance optimization for fission counters.** Valentine, K.H.; Pare, V.K. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 696-697(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 28954, 29034, 29035, 29075

29549 **Status of compton recoil gamma-ray spectroscopy.** Gold, R.; Kaiser, B.J. (Hanford Engineering Development Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 692-693(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 29523, 29791

29550 **Polarized targets.** Yokosawa, A. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 110-121(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The design of the LMN target and its use in spin physics are reviewed.(AIP)

29551 **Effective mass spectrometer.** Ayres, D. (Argonnes National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 122-142(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The history and major accomplishments of the Effective Mass Spectrometer (EMS) are described. In the eight years since the EMS turned on, 21 experiments have been completed by groups from nine institutions in 32 months of operation. Over 400 million triggers have been recorded on magnetic tape, resulting in 29 journal publications to date. A list of experimental proposals for the EMS and a sampling of results are presented.

29552 **History of the polarized beam.** Parker, E.F. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **60**: No. 1, 143-157(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

In 1973, the first high energy polarized proton beam was developed at the Argonne Zero Gradient Synchrotron (ZGS). It operated very successfully and productively until 1979 when the ZGS was shut down permanently. This report describes the development, characteristics, and operations of this facility.

29553 Design engineer's view of the ZGS. Bywater, J. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* 60: No. 1, 173-177(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The design problems of magnets and targets in the ZGS are discussed. (AIP)

29554 Engineer's view of the ZGS. Kustom, R.L. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* 60: No. 1, 181-189(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The installatin of the titanium vacuum chamber is recounted. (AIP)

29555 Trajectory detector for the measurement of short lived activity by decay in flight. Bart, S.M.; Hungerford, E.V. (Houston Univ., TX (USA). Dept. of Physics); Vrba, J.A.; Bingham, C.R. (Tennessee Univ., Knoxville (USA)); Cleary, T.P.; Gross, E.E.; Hensley, D.C. (Oak Ridge National Lab., TN (USA)). *Nucl. Instrum. Methods;* 167: No. 2, 209-214(Dec 1979).

A trajectory detector especially suited to the measurement of charged particle decay energies and half lives by a decay in flight technique is described. With recoil velocities presently available at heavy-ion accelerators, the apparatus provides a low background method for in-beam investigation of α-decay in the 1-100 ns half life range. The method is demonstrated for the α-decay of ^{217}Ac made in the reaction ^{208}Pb(^{14}N,5n)^{217}Ac.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 29335

29556 (SAND—80-0843C) SEM technique for experimentally locating latch-up paths in integrated circuits. Dressendorfer, P.V.; Armendariz, M.G. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 4p. (CONF-800703—1). NTIS, PC A02/MF A01.

From Annual conference on nuclear and space radiation effects; Ithaca, NY, USA (15 Jul 1980).

A technique is presented for using the scanning electron microscope (SEM) in the electron-beam-induced current (EBIC) mode to delineate latch-up paths in CMOS ICs. In the EBIC mode, the current produced by the collection and separation of the electron-beam-generated electron-hole pairs in the space charge regions of the device is measured and used to form an image. Since the collection of these carriers is dependent on space charge region width (and thus junction potential), anything that alters the depletion layer width will affect the collection efficiency. In a latch condition the junctions involved in the latch will be biased differently from those which are not, and thus the EBIC signal from those regions should be measurably different.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 28897, 29045, 29146, 29622, 29642

29557 Leak test fitting. Pickett, P.T. US Patent Application 076,527. [nd]. 10p.

A hollow fitting for use in gas spectrometry leak testing of conduit joints is divided into two generally symmetrical halves along the axis of the conduit. A clip may quickly and easily fasten and unfasten the halves around the conduit joint under test. Each end of the fitting is sealable with a yieldable material, such as a piece of foam rubber. An orifice is provided in a wall of the fitting for the insertion or detection of helium during testing. One half of the fitting also may be employed to test joints mounted against a surface.

29558 (BNL—28015) Temperature effects in dip-tube manometry. Keisch, B.; Suda, S. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 13p. (CONF-800655—28). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

A simple mathematical treatment of the temperature dependence of manometric data for dip-tubes is described. It is shown that the pressure probe measurement is a function of the mass, temperature, and liquid level heights below and above the effective tip of the probe. The resulting equations explain why, for example, high- and low-level probes exhibit temperature sensitivity that is opposite in sign to one another. The derived equations are successful in the prediction of actual data obtained for two differently-shaped vessels containing two different liquids.

29559 (EPRI-EA—1434) Development and evaluation of a prototype automated telephotometer system. Final report. Viezee, W.; Evans, W.E. (SRI International, Menlo Park, CA (USA)). Jun 1980. 56p. NTIS, PC A04/MF A01.

Hardware and software components of an automated telephotometer system to monitor daytime visibility and visibility degradation in pristine air quality areas are assembled and calibrated. The objective was to produce and deliver a prototype, fieldable device supported by design and maintenance documentation. The optical sensor is a Reticon solid-state line scanner with a 15-degree viewing angle in a single vertical plane. When directed at a distant scene or landmark, the camera gives a brightness measurement at 256 successive elements along the vertical scanline, thereby providing a detailed profile of scene brightness. Brightness measurements are recorded in terms of the light intensity integrated over the standard spectral (photopic) response of the human eye. A computer-controlled, lightweight rotator scans the sensor in azimuth at 1.57 milliradian increments. Two computer algorithms are implemented into the prototype system. One computes average brightness across selected landmarks or vistas and across nearby portions of the background sky to determine apparent brightness contrast. The other algorithm determines the brightness structure or brightness standard deviation across selected vistas to evaluate contrast structure which is related to the amount of terrain detail or the texture of a geographic feature visible to a distant observer. The output from both algorithms provides information which is fundamental to the further development of the concept of atmospheric visibility and visibility impairment.

29560 (LA-UR—80-1608) Portable radio frequency hyperthermia instrumentation. Doss, J.D.; McCabe, C.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-800665—1). NTIS, PC A02/MF A01.

From 3. international symposium on cancer therapy by hyperthermia, drugs, and radiation; Ft Collins, CO, USA (22 Jun 1980).

Portable radio frequency hyperthermia instrumentation has been constructed for application in the localized heating of human and animal tumors. Tissue temperature is regulated by electronic feedback techniques. Audible and visual monitoring of tissue temperature is provided.

29561 New, more efficient conduction cooling device for low temperature phosphorimetry. Ward, J.L.; Walden, G.L.; Bateh, R.P.; Winefordner, J.D. (Department of Chemistry, University of Florida, Gainesville, Florida 32611). EP-78-S-05-6022. *Appl. Spectrosc.;* 34: No. 3, 348-350(May 1980).

Conduction cooling has been shown to be a viable means of improving precision and convenience in low temperature phosphorimetry. A new conduction cooling device is presented and evaluated. With this new device, phosphorimetry can now more practically be applied to routine analysis situations. Analytical figures of merit are given for several compounds as a means of comparison of conduction-cooled phosphorescence with immersion-cooled phosphorescence.

29562 Electron beam collector for a microwave power tube. Dandl, R.A. (to Dept. of Energy). US Patent 4,189,660. 19 Feb 1980. Filed date 16 Nov 1978. 4p.

PAT-APPL-961,175.

This invention relates to a cylindrical, electron beam collector that efficiently couples the microwave energy out of a high power microwave source while stopping the attendant electron beam. The interior end walls of the collector are a pair of facing parabolic mirrors and the microwave energy from an input horn is radiated between the two mirrors and reassembled at the entrance to the output waveguide where the transmitted mode is reconstructed. The mode transmission through the collector of the present invention has an efficiency of at least 94%. 2 claims.

29563 Beam/seam alignment control for electron beam welding. Burkhardt, J.H.; Henry, J.J.; Davenport, C.M. (to Dept. of Energy). US Patent 4,183,055. 8 Jan 1980. Filed date 24 Aug 1978. 6p.

PAT-APPL-936,458.

This invention relates to a dynamic beam/seam alignment control system for electron beam welds utilizing video apparatus. The system includes automatic control of workpiece illumination, near infrared illumination of the workpiece to limit the range of illumination and camera sensitivity adjustment, curve fitting of seam position data to obtain an accurate measure of beam/seam alignment, and automatic beam detection and calculation of the threshold beam level from the peak beam level of the preceding video line to locate the beam or seam edges. 4 claims.

29564 Aerosol impactors: calculation of optimum geometries. Ravenhall, D.G.; Forney, L.J. (Univ. of Illinois, Urbana). *J. Phys., E (London);* 13: 87-91(1980).

Optimum properties of particle inertial impactors for a two-dimensional ideal fluid are derived using conformal mapping techniques and improved numerical methods. Results of sequential calculations of one-dimensional contour integrals are matched with analytical expressions for fluid properties near the stagnation point. Particle trajectories are numerically simulated for a range of jet-to-plate spacings and fluid deflecting plate angles. These results are compared with the calculations of Davies and Aylward for a deflecting plate angle $\beta = 90^0$. It is found that an unconventional angle β not equal to 90^0 exists for a given jet-to-plate spacing which maximises the slope of the particle efficiency curves. Although the conclusions are derived for an ideal fluid ($Re = \infty$), similar results should apply for impactors operating at finite Reynolds numbers.

29565 Recent developments at the TRISTAN on-line mass separator. Brenner, D.S. (Clark Univ., Worcester, MA); Chrien, R.E.; Gill, R.; Stelts, M.; Hill, J.C.; Wohn, F.K. pp 389-396 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Company (1980).

From Proceedings of the international symposium on future directions in studies of nuclei far from stability; Nashville, TN (10 Sep 1979).

TRISTAN mass separator has been moved to the HFBR reactor at BNL. Improvements and modifications are described. (FS)

29566 Dual beam fiber optic time-of-flight spectrometer. Whitten, W.B.; Ross, H.H. (Oak Ridge National Lab., TN). *Anal. Chem.;* **52**: 101-104(1980).

A dual beam spectrometer has been constructed which uses the variation in light velocity with wavelength in an optical fiber to provide spectral dispersion in the time domain. Two fibers of different lengths constitute the sample and reference channels which are time-delay multiplexed and monitored by a single photomultiplier. Time-correlated single photon counting techniques provided the necessary timing accuracy for satisfactory spectral resolution.

29567 Application of matrix isolation spectroscopy to the measurement of sputtering yields. Steinbruechel, C.; Gruen, D.M.; Dawson, J. (Argonne National Lab., IL). *J. Vac. Sci. Technol.;* **16**: No. 2, 251-254(Mar 1979).

Matrix isolation spectroscopy has been used to measure sputtering yields of D+ and Ar+ on Au and Ti in the energy range 0.25 to 2.0 keV. The technique involves bombarding a target with ions produced by a sputter ion gun, collecting sputtered atoms in a cryogenic noble gas matrix, and determining the amount of metal collected by optical spectroscopy. The present preliminary results are compared with previous results obtained by more conventional experimental techniques.

29568 Energy gap in the phonon dispersion of the linear mercury chains in Hg/sub 3-δ/AsF$_6$. Heilmann, I.U. (Brookhaven National Lab., Upton, NY); Hastings, J.M.; Shirane, G.; Heeger, A.J.; MacDiarmid, A.G. *Solid State Commun.;* **29**: 469-471(1979).

Inelastic neutron scattering measurements of Hg-chain excitations in Hg/sub 3-δ/AsF$_6$ are presented. Below T/sub c/ = 120°K, where the Hg-ions develop an ordered sublattice, a small but well-defined gap in the Hg-chain dispersion develops at finite q. The response of the Hg-chain does not involve an elastic component indicating the absence of defect-or impurity-interactions along the chains.

29569 Spurious ringing in pulse NMR. Fukushima, E.; (Los Alamos Scientific Lab., NM); Roeder, S.B.W. *J. Magn. Resonance;* **33**: 199-203(1979).

The theory of electromagnetic generation of ultrasonic standing waves in metals is reviewed and applied to the problem of spurious ringing detected in pulse NMR. The theory predicts that the spurious signal is proportional to the transmitter pulse amplitude and the square of the static field intensity. It also depends on some material properties and geometrical factors. A table of pertinent properties for various metals is presented showing that aluminum is one of the worst materials. Experiments confirm that replacement of aluminum with other metals in the probe attenuates the spurious signal and that the ringing of the coil is attenuated by a judicious choice of wire size.

WELL LOGGING INSTRUMENTATION

29570 Uranium borehole logging benchmark measurements and methods. Verbinski, V.V. (Science Applications, Inc., San Diego, CA); Stamatelatos, M.; Cassapakis, C.G.; Patricelli, F.; Wilson, R.D. *Trans. Am. Nucl. Soc.;* **33**: 667-668(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

29571 Perfluorocarbon vapor tagging of blasting cap detonators. Dietz, R.N.; Senum, G.I. US Patent Application 009,623. [nd]. 16p.

A plug for a blasting cap is made of an elastomer in which is dissolved a perfluorocarbon. The perfluorocarbon is released as a vapor into the ambient over a long period of time to serve as a detectable taggant.

29572 (LA-UR—80-329) Nature of the buildup to detonation in solid high explosives during plane shock initiation. Dick, J.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 24p. (CONF-800809—3). NTIS, PC A02/MF A01.

From 18. combustion symposium; Waterloo, Canada (17 Aug 1980).

Two models for the initiation process are compared to results of experimental studies of initiation of detonation in two high explosives, PBX-9404 (HMX-based) and PBX-9502 (TATB-based), by sustained shock waves. A critical examination of the model known as single-curve buildup is made. Several comparisons are made with experimental results for the two explosives. The model describes the observed shock trajectories moderately well although it has some limitations. These are manifested by an examination of the relation between input pressure and distance of run to detonation. The data are also compared with model solutions for the initiation process which assume self-similar flow. The model can fit the experimental shock trajectory reasonably well but difficulties are encountered in attempting to complete the solution for the entire flow field. For PBX-9404, published pressure-time profiles are examined for self-similar character. The measured profiles show substantial disagreement with the similarity model.

29573 Thermally stable, plastic-bonded explosives. Benziger, T.M. (to Dept. of Energy). US Patent 4,168,191. 18 Sep 1979. Filed date 29 Jun 1978. 6p.

PAT-APPL-920,415.

By use of an appropriate thermoplastic rubber as the binder, the thermal stability and thermal stress characteristics of plastic-bonded explosives may be greatly improved. In particular, and HMX-based explosive composition using an oil-extended styrene-ethylenebutylene-styrene block copolymer as the binder exhibits high explosive energy and thermal stability and good handling safety and physical properties. 6 claims.

NUCLEAR

29574 (LA-UR—80-1107) Characterization of low-loss multimode optical fibers for nuclear diagnostics. Ogle, J.W.; Nelson, M.A.; Davies, T.J.; Lutz, S.; Lin, C.H.; Theobald, K.; Franks, L.A.; Norris, N.J.; Lyons, P.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 18p. (CONF-800307—7). NTIS, PC A02/MF A01.

From Fiber optic in the nuclear environment symposium; Adelphi, MD, USA (25 Mar 1980).

The application of low loss multimode optical fibers to nuclear diagnostics has been discussed in previous papers. Fiber requirements for this application differ substantially from those for normal communications use. The emphasis for nuclear measurements has been on development of high frequency analog fiber optic transmission line systems, which range from 100 MHz to > 500 MHz signals transmitted at 600 nm and 800 nm, respectively. Accordingly, specialized fiber characterization procedures over a wide spectral range have been developed. These techniques include measurement of material and modal dispersion, optical attenuation, and optical linearity. It is also important to know the prompt radiation response of optical fibers in nuclear diagnostics. Measurements of this type have been discussed in previous papers.

CIVIL USES

29575 (UCID—18640) Response to critique of my paper entitled, "A Novel Scheme for Making Cheap Electricity". (UCID-18153). Pettibone, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1979. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01.

Responses are presented to a critique of a paper in which a scheme was proposed to replace a reactor/steam turbine system with an engine in which the expansion of a gas heated by a nuclear explosion raises a mass of liquid, resulting in stored hydraulic energy. The energy could be converted to electricity by hydroelectric generation with water as the working fluid or by MHD generation with molten metal. In particular, critiques by Jim Bell and Gary Higgins, are noted and discussions are provided for the following:

the anti-Nuke sentiment; cost estimation; construction technique for the expansion chamber; safety; life shortening damage to the expansion chamber; radioactive liquid going through the turbine; nuclear charge design and cost; formulas; and U-shaped free piston engine. A novel scheme for making cheap electricity with nuclear energy appeared in Energy Research Abstracts (4:57084) as UCID-18153 (Rev. 1).

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 29589, 29696

29576 (BNL—51146) **Air-sea interaction experiments (1976) at an offshore platform near Atlantic City, New Jersey.** SethuRaman, S.; Tuthill, W.A.; McNeil, J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract AC02-76CH00016. 15p. NTIS, PC A02/MF A01.

Air-sea interaction experiments conducted at an offshore platform near Atlantic City, New Jersey, during September 14-23, 1976, are described in this report. Momentum flux was measured by the eddy correlation method. Wave height, slope, and direction spectra were estimated from wave height variations measured by an array of wave staffs positioned in the corners of an equilateral triangle. Some preliminary results of the analysis are also presented.

29577 (COO—2195-33) **Climatic fluctuations, volcanic aerosol and carbon dioxide changes. Annual progress report, 1 October 1979-30 September 1980.** Newell, R.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology). 21 May 1980. Contract AS02-76EV12195. 11p. NTIS, PC A02/MF A01.

Technical progress made for the contract period 1 October 1979-30 September 1980, and in fact since the last progress report was prepared on 18 June 1979, is summarized. The relationship between tropospheric air temperature, sea surface temperature patterns and volcanic aerosol has been derived by the application of generalized least squares analysis, which takes account of significant autocorrelation between the variables. Up to 50% of the variance of the tropical tropospheric air temperature can be explained in terms of preceding values of the variables. The technique is being applied to make a preliminary climatic forecast of the effect of the Mt. St. Helen's eruption of 18 May 1980 on zonal mean Northern Hemisphere temperature. A regression approach was used to forecast winter temperature over the continental US using parameters from out data base. Techniques for experimental climatic forecasting are being developed and studies of the background sea-air interaction processes are being made. We have shown that surface effects extend up to at least 500 mb in the atmosphere. Tropical rainfall has been found to vary with the Southern Oscillation Index; this rainfall provides the main energy supply to the atmosphere in the form of latent heat liberation.

29578 (UCRL—50042-79) **Annual report of Lawrence Livermore Laboratory to the FAA on the high altitude pollution program, 1979.** Luther, F.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1979. Contract W-7405-ENG-48. 75p. NTIS, PC A04/MF A01.

Progress in two major research areas is reported. They are numerical modeling of the atmospheric response to stratospheric perturbations, and the processing, archiving, and analysis of satellite ozone data. Each of these research areas has been divided into a number of subtasks. Those reported under atmospheric modeling are: model simulations of stratospheric observations; potential changes in ozone resulting from other perturbations; effects of speculative reactions and mechanisms; and stratospheric water vapor. Subtasks of the research on satellite ozone data processing, archiving, and analysis include: radiative transfer and retrieval methodology; data basing and data processing; and data analysis. One of two appendixes includes a description of a one-dimensional transport-kinetics model.

29579 (UCRL—84092) **Spacially-averaged and point measurements of wind variability in the Geyser's area.** Porch, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1980. Contract W-7405-ENG-48. 30p. (CONF-800480—1). NTIS, PC A03/MF A01.

From ASCOT program planning meeting; Gettysburg, PA, USA (15 Apr 1980).

This paper describes the results of a comparison of wind measurements made with conventional cup-vane tower mounted anemometers and optical space-averaged anemometer techniques. The results described cover the period from 7/17/79 to 7/27/79 during the intensive ASCOT experiment in the Geyser's region. The average height of the laser beam above terrain was about 30 meters. Most of the optical anemometer wind data was obtained using a laser beam system described in detail by Lawrence, et al. Some measurements were also made along the same path using a white light photodiode array system developed at LLL.

29580 **Expanded use of fossil fuels by the US and the global carbon dioxide problem.** Emanuel, W.R.; Olson, J.S.; Gillough, G.G. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Manage.;* **10**: 37-49(1980).

Projecting present increases in rates of fossil fuel utilization, a doubling of CO_2 concentration in the atmosphere may be expected within the next 75 years. Based on preliminary calculations, coal utilization by the United States to the year 2020 accounts for between 9 and 15% of the increase in CO_2 concentration. Carbon dioxide in the atmosphere absorbs infra-red radiation, causing an increase in the surface temperature of the earth. The most recent climatic models indicate that each doubling in atmospheric CO_2 concentration will result in a temperature increase of approximately 3 +- 1°C, depending on the model used. Changes in average rates of precipitation and evaporation may follow, leading to higher probabilities of drought in the mid-latitudes (including the United States). Manabe and Wetherald (1975) have estimated the temperature increase at high latitudes to be three times the increase in the global average surface temperature. Large-scale melting of the polar ice caps and a subsequent increase in the surface area of the oceans may follow on a timetable that is not yet clear. The distribution of vegetation and agricultural activities can be expected to change in response to the temperature increase and associated changes in precipitation and evaporation. The many uncertainties associated with the analysis of the carbon dioxide/climate problem mandate the initiation of an immediate global-scale interdisciplinary research effort to determine more clearly the components and connections of the problem and to develop strategies for reducing the impacts, i.e., contingency plans that could be helpful regardless of impact details which remain to be determined.

29581 **Atmospheric nuclear tests of the 1950's and 1960's: a possible test of ozone depletion theories.** Chang, J.S.; Duewer, W.H.; Wuebbles, D.J. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Geophys. Res.;* **84**: No. C4, 1755-1765(20 Apr 1979).

It will be shown that the model chemistries used to calculate the effects of supersonic transports for Climatic Impact Assessment Program and National Research Council studies and of large-scale nuclear exchanges for National Research Council studies cause our one-dimensional model to predict ozone depletions in 1963-1964 resulting from NO/sub x/ injected into the stratosphere by the atmosphere nuclear tests of 1956-1962 larger (4 to 14% ozone reduction in 1963) than is easily consistent with observation. However, calculations carried out with more recent model chemistries result in ozone reductions that are more easily consistent with observation.

29582 **Calibration and use of a sailplane variometer to measure vertical velocity fluctuations.** Sethuraman, S.; Brown, R.M.; Raynor, G.S.; Tuthill, W.A. (Brookhaven National Lab., Upton, NY). *Boundary-Layer Meteorol.;* **16**: 99-105(1979).

The calibration of a sailplane variometer to measure vertical velocity fluctuations in the atmospheric boundary layer is described. Its usefulness is demonstrated with typical results from a boundary-layer development study. The atmospheric calibrations gave the ratio of standard deviations of vertical velocity fluctuations measured by a standard tower-mounted turbulence instrument to the values measured by variometer as 2.5 $m\ s^{-1}V^{-1}$.

29583 (DOE/SR/01025—T1) **Oceanographic and meteorological data 15 km off the coast of Georgia. Data report No. 2.** Blanton, J.O.; Bailey, L.L.; Hayes, D.W.; Dicks, A.S. (Skidaway Inst. of Oceanography, Savannah, GA (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [nd]. Contract AS09-77SR01025. 63p. NTIS, PC A04/MF A01.

This series of data reports provides graphical display of environmental data from the nearshore continental shelf off the Georgia coast. The data are automatically recorded on the Savannah River Navigational Light Tower located about 15 km offshore at an ocean depth of 16 meters. Meteorological data consist of air temperature, wind velocity, and barometric pressure. Oceanographic data include ocean temperature at 6 depths and ocean currents at 2 depths. The graphical presentations consist of displays of the hourly averages over a 16 week period from May to September 1977. The data are also smoothed and displayed as 6-hourly averages from which the tidal and other short period fluctuations have been removed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 28338, 28923, 28924, 29405, 29578, 29581, 29602

29584 (ANL/EES-TM—89) **Nonattainment of national ambient air quality standards: implications for energy policy.** Garvey, D.B.; Streets, D.G.; Kotecki, R.; Senew, M. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 151p. NTIS, PC A08/MF A01.

In accordance with the 1977 Clean Air Act Amendments, EPA established regulations governing new and existing sources of emissions in areas where the NAAQS are being exceeded. These requirements may constrain the implementation of a national energy policy to increase the use of coal in utilities and industries. The states designated the nonattainment areas and prepared State Implementation Plans, outlining strategies for attaining the standards by the deadline of December 31, 1982. This report contains maps of nonattainment areas for all pollutants and summaries of the attainment strategies for those pollutants most likely to affect fossil-fueled energy development - SO_2, TSP, and NO/sub x/. The review of SIPs indicates that attainment of SO_2 standards should be relatively easy. Attainment of TSP standards may be more difficult since point sources are already well controlled and further reductions in emissions will require controls on fugitive sources. NO/sub x/ nonattainment is currently limited to three small areas. The report also contains an examination of emission limitations in nonattainment areas and a national assessment of the potential constraints of nonattainment on energy development in 1985 to 1990. The assessment concludes that constraints on projected new coal-fired utilities should not be significant. Constraints on expanded industrial coal use from TSP nonattainment may be significant but the effects of SO_2 nonattainment should be limited.

29585 (BNL—27956) **Characterization and quantification of the oxides of sulfur and nitrogen and associated compounds in their gaseous, aerosol, and dissolved states.** Newman, L. (Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 28p. (CONF-800560—2). NTIS, PC A03/MF A01.

From International conference on air pollutants and their effects on the terrestrial ecosystem; Banff, Alberta, Canada (May 1980).

The needs and problems associated with the characterization and quantification of the oxides of sulfur and nitrogen and associated compounds in their gaseous, aerosol, and dissolved states are discussed. Illustrations are given of the techniques in present usage for the determination of the substances of interest to investigators concerned with the effects of air pollutants on the terrestrial ecosystem. The value and utility of the newer techniques employing real time continuous instrumentation are presented and compared with the more traditional approaches utilizing sampling collection. A plea is made to provide resources for data reduction especially in order to obtain constructive utilization of continuous instrumentation. It is asserted that real time instrumentation is best utilized during campaign measurement programs where short time resolution is required and that collection techniques still have a place, especially in long term monitoring efforts. Special attention was directed at, and the problems highlighted that are associated with, the utilization of the real time instruments available for the flame photometric determination of the oxides of sulfur and the chemiluminescent measurement of the oxides of nitrogen. The newer methods proposed for their use in the determination of sulfate and nitric acid respectively are presented. The difficulties associated with the determination of nitrate are enunciated and attention focused on the problems of obtaining a sample due to the variation of the vapor pressure of gaseous nitric acid and ammonia above solid ammonium nitrate which is in association with an acidic aerosol containing sulfate. The utility of measurements of the composition of rainwater is discussed in light of its application to determine the mechanisms through which rain derives its chemical composition.

29586 (CONF-800560—1) **Air pollutant interactions with vegetation: research needs in data acquisition and interpretation.** Lindberg, S.E.; McLaughlin, S.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 87p. NTIS, PC A05/MF A01.

From International conference on air pollutants and their effects on the terrestrial ecosystem; Banff, Alberta, Canada (May 1980).

The objective of this discussion is to consider problems involved in the acquisition, interpretation, and application of data collected in studies of air pollutant interactions with the terrestrial environment. Emphasis will be placed on a critical evaluation of current deficiencies and future research needs by addressing the following questions: (1) which pollutants are either sufficiently toxic, pervasive, or persistent to warrant the expense of monitoring and effects research; (2) what are the interactions of multiple pollutants during deposition and how do these influence toxicity; (3) how de we collect, report, and interpret deposition and air quality data to ensure its maximum utility in assessment of potential regional environmental effects; (4) what processes do we study, and how are they measured to most efficiently describe the relationship between air quality dose and ultimate impacts on terrestrial ecosystems; and (5) how do we integrate site-specific studies into regional estimates of present and potential environmental degradation (or benefit).

29587 (DP-MS—80-13) **Investigation of multi-dimensional computational models for calculating pollutant transport.** Pepper, D.W.; Cooper, R.E.; Baker, A.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Tennessee Univ., Knoxville (USA)). 1980. Contract AC09-76SR00001. 16p. (CONF-800492—1). NTIS, PC A02/MF A01.

From Southeastern conference on theoretical and applied mechanics; Knoxville, TN, USA (17 Apr 1980).

A performance study of five numerical solution algorithms for multi-dimensional advection-diffusion prediction on mesoscale grids was made. Test problems include transport of point and distributed sources, and a simulation of a continuous source. In all cases, analytical solutions are available to assess relative accuracy. The particle-in-cell and second-moment algorithms, both of which employ sub-grid resolution coupled with Lagrangian advection, exhibit superior accuracy in modeling a point source release. For modeling of a distributed source, algorithms based upon the pseudo-spectral and finite element interpolation concepts, exhibit improved accuracy on practical discretizations.

29588 **Reactions of organic pollutants. I. Ozonation of acenaphthylene and acenaphthene.** Chen, P.N.; Junk, G.A.; Svec, H.J. (Ames Lab., IA). *Environ. Sci. Technol.;* **13**: No. 4, 451-454(Apr 1979).

The polyaromatic hydrocarbons, acenaphthylene (1) and acenaphthene (2), were ozonated separately in hexane (H), in methanol (M), and in water (W). The reaction products were separated and identified by packed column gas chromatography, combintion gas chromatography/mass spectrometry, and NMR and IR spectroscopy. The major products from the ozonation of 1 in the three solvent systems were: 1,8-naphthalenedialdehyde (H,M,W); 1,8-naphthalene anhydride (H,M,W); methyl 8-formyl-1-naphthoate (M); dimethoxyacetal 1,8-naphthalenedialdehyde (M); 1,2-epoxy acenaphthylene (W); 1-naphthoic acid (W); and 1,8-naphthaldehydic acid (W). The major products from the ozonation of 2 were: 7-formyl-1-indanone (H,M,W); methyl 1-indanone-7-carboxylate (M); 1-indanone (M,W); 7-hydroxy-1-indanone (M,W); 1-indanone-7-carboxylic acid (W); indane-1,7-dicarboxylic acid (W); and indane-1-formyl-7-carboxylic acid (W). Reaction pathways are proposed for some of these identified products.

29589 (LA-UR—80-1824) **Analysis of fluorescent particle tracer data.** Clements, W.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 20p. (CONF-800489—1). NTIS, PC A02/MF A01.

From Gettysburg ASCOT meeting; Kelseyville, CA, USA (14 Apr 1980).

Four fluorescent particle tracer experiments were conducted during the July 1979 ASCOT experiment in the Anderson Creek Valley of northern California. The purpose of the experiment was to examine the transport and elongation of a plume traveling in the Anderson Creek nocturnal drainage flow and investigate the interaction of the Anderson Creek and Putah Creek flow fields. Sequential samples of tracer material at three downwind locations in Anderson Creek gave effective transport velocities of 1 to 2 m/s and showed an approximately linear relationship between plume elongation and travel distance. Integrated samples taken in both the Anderson Creek and Putah Creek air sheds indicated considerable interaction between the two flow fields.

29590 (SAND—80-1173C) **Interpretation of volcanic gas data from tholeiitic and alkaline mafic lavas.** Gerlach, T.M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 28p. (CONF-800729—1). NTIS, PC A03/MF A01.

From International workshop on the analysis and interpretation of volcanic gases; Gif-sur-Yvette, France (3 Jul 1980).

Data are tabulated for approximately 150 previously reported collections of high-temperature volcanic gases from basic lavas using computational techniques recently introduced by the author. Research problems dealing with the composition of volcanic gases and their relation to lava chemistry are outlined. The need for more accurate data on the volume of gases released during eruptions is also noted. (PCS)

29591 (UCID—18739) **Intercomparison of preliminary MFR, SBUV, TOMS, and TOVS total ozone data.** Luther, F.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 9 Jul 1980. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01.

A comparative study of total ozone data derived from various satellite instruments is being conducted. The instruments included in the study are the DMSP Multichannel Filter Radiometer (MFR), the

NASA Solar Backscatter Ultraviolet Ozone Experiment (SBUV), the NASA Total Ozone Mapping Spectrometer (TOMS), and the NOAA Tiros Operational Vertical Sounder (TOVS). The two periods chosen for data intercomparison are January 1 to February 15, 1979 and June 1 to 30, 1979. These two data periods cover summer and winter regimes in both hemispheres. The January 1 to February 15, 1979 period includes a significant stratospheric warming event that began about January 15. Preliminary data from each of the instruments were processed for the first data period. The total ozone data have been made available for analysis with the understanding that they may be changed at a later date. The data do not represent the final data products, but they are useful for determining the characteristics of the data retrieval schemes, and early intercomparison of the data may lead to improvements in the ozone retrieval methodology. Results indicate that each of the satellite instruments has its own strengths and weaknesses. No instrument is universally better than or worse than any other in terms of accuracy, although they appear to have definite biases in certain geographical areas. The differences between the satellite systems is greatest at high latitudes where cloudiness and ozone variabilities are greatest. The Dobson data show a bias and differing degrees of ozone variability between nearby Dobson stations, which indicates there may be problems with using the Dobson data as a standard for comparison.

29592 Environmental assessment of fluidized-bed combustion systems. Murthy, K.S. (Battelle Pacific Northwest Labs, Wash). *CHEMTECH;* **10**: No. 1, 58-62(Jan 1980).

EPA and DOE are involved in intensive efforts to speed the development of the fluidized-bed combustion process while simultaneously assessing the potential environmental impact of the process. The development of the FBC process since the 1920's is traced. The FBC process and its associated technology are described. Potential pollutants from the process are discussed. By 1985, environmentally safe fluidized-bed combustors are expected to be on the U.S. market. (4 diagrams, 1 drawing)

29593 Precipitation acidity: the role of the forest canopy in acid exchange. Hoffman, W.A.; Lindberg, S.E.; Turner, R.R. (ORNL). *J. Environ. Qual.;* **9**: No. 1, 95-100(Jan-Mar 1980).

Individual rain episodes were sampled above and below a forest canopy in Tennessee to analyze acidity and organic content. Although weak acids constituted 30% of the total acidity of incident rain and increased to more than 50% in throughfall, the increase cannot be attributed entirely to the presence of organic acids. Strong acid is partially removed from rain at the leaf surface. (4 graphs, 35 references, 2 tables)

29594 Initial comparison of SURE/MAP3S sulfur oxide observations with long-term regional model predictions. McNaughton, D.J. (Battelle Pacific Northwest Labs, Wash). *Atmos. Environ.;* **14**: No. 1, 55-63(1980).

Recent data acquisition by the Sulfate Regional Experiment (SURE) program and the Multistate Atmospheric Power Production Pollution Study (MAP3S) has provided data that reflect the development of regional model formulations. Monthly averages of sulfates and total sulfur removed by precipitation are surveyed. The SURE and MAP3S predictive models should incorporate functions that describe transport and transformation of sulfur oxides in subcloud and incloud environments. (5 graphs, 5 maps, 15 references, 3 tables)

29595 Determination of ambient aerosol sulfur using a continuous flame photometric detection system: Part I. Tanner, R.L.; D'Ottavio, T.; Garber, R.; Newman, L. (US Brookhaven Natl Lab, NY). *Atmos. Environ.;* **14**: No. 1, 121-127(1980).

A system for the measurement of ambient levels of aerosol sulfur using a flame photometric sulfur analyzer with a heated denuder for sulfur dioxide removal has been developed. Cyclic addition of ammonia permits discrimination between sulfuric acid and other sulfate aerosols. The effects of changes in atmospheric parameters on system response, such as changes in barometric pressure and water vapor concentration, are described. (2 diagrams, 5 graphs, 30 references)

29596 Determination of total inorganic nitrate utilizing collection of nitric acid on nacl-impregnated filters. Forrest, J.; Tanner, R.L.; Spandau, D.; D'Ottavio, T.; Newman, L. (US Brookhaven Natl Lab, NY). *Atmos. Environ.;* **14**: No. 1, 137-144(1980).

Cellulose filters impregnated with sodium chloride will collect nitric acid vapor from ambient atmospheres at efficiencies of 95% when placed downstream from a pretreated quartz particle filter in a high volume sampler. No adsorption of nitrogen dioxide on the sodium chloride filters with retention as nitrate was observed. (2 graphs, 22 references, 7 tables)

29597 Mercury partitioning in a power plant plume and its influence on atmospheric removal mechanisms. Lindburg, S.E. (Oak Ridge National lab., TN). Contract W-7405-ENG-26. *Atmos. Environ.;* **14**: 227-231(1980).

Air samples were collected isokinetically in the plume of a major coal-fired power plant during helicopter flights. The dominant form of mercury in the plume was elemental Hg vapor, ranging from 92 to 99% of the total Hg concentration in air. There was no evidence of significant gas to particle conversion during plume aging. The predominance of the vapor form is conducive to long-range transpot and removal by precipitation scavenging.

29598 Lima bean proteinase inhibitor. Origins of circular dichroism bands and modification by Br_2^- and $(CNS)_2^-$. Kay, E.; Gumbiner, B. (Univ. of California, Los Angeles). Contract EY-76-C-03-0012. *J. Biol. Chem.;* **254**: No. 16, 7643-7647(25 Aug 1979).

Origins of CD bands in lima bean proteinase inhibitor were deduced from an acetylation-deacetylation study of the sole tyrosyl residue in the protein (Tyr 69), and by analogy with Bowman-Birk soybean proteinase inhibitor. A broad negative CD band centered around 280 nm arises mainly from the longest wavelength transition of cystinyl side chains. The second cystinyl transition gives rise to a positive CD band of a comparable intensity at 247 nm. the ^{1}L/sub b/ vibronic transition of Tyr 69 has negative CD around 280 nm, contributing approximately 10% of the total CD intensity at 278 nm. the 232 nm positive shoulder is from the ^{1}L/sub a/ vibronic transition of Tyr 69. Radical anions, Br_2^- and $(CNS)_2^-$, generated by the irradiation of N_2O-saturated inhibitor solutions containing KBr or KCNS, reduced tyrosyl CD without affecting disulfide CD bands, indicating that the radical anions damaged Tyr 69 without altering protein conformation. The inhibitor modified at Tyr 69 by Br_2^- and $(CNS)_2^-$ retained full activity toward trypsin and chymotrypsin. The irradiation of the inhibitor in the air saturated solution led to loss in tyrosyl as well as cystinl CD bands and decline in both antiproteinase activities.

29599 Experimental evidence of interhemispheric transport from airborne carbon monoxide measurements. Newell, R.E. (Massachusetts Inst. of Tech., Cambridge); Gauntner, D.J. *J. Appl. Meteorol.;* **18**: No. 5, 696-699(May 1979).

Measurements of carbon monoxide made in the equatorial upper troposphere on a Pan American flight around the world accomplished in under three days show large changes with longitude that are interpreted as direct evidence of interhemispheric mixing.

29600 Aerial inputs of cadmium, copper, lead, and manganese into a freshwater pond in the vicinity of a coal-fired power plant. Wiener, J.G. (Savannah River Ecology Lab., Aiken, SC). Contract EY-76-C-09-0819; W-7405-ENG-26. *Water, Air, Soil Pollut.;* **12**: 343-353(1979).

Cadmium, Cu, Mn, and Pb were analyzed in bulk precipitation for 21 mo at a 2 ha pond, located 5.5 km northwest of an 83 MW coal-fired power plant in South Carolina. No significant changes in mean concentrations of the four metals in bulk precipitation were observed after installation of modern electrostatic precipitators on the stacks of the power plant, which had previously been equipped with mechanical cyclone collectors for removal of fly ash. Hence, fly ash from stack emissions was apparently not a major source of aerially deposited trace metals at the pond site. Annual inputs of the four metals in bulk precipitation at the pond were similar to values reported for other rural areas in North America. Enrichment factors, with Mn as a reference element, indicated that Cd, Cu, and Pb in bulk precipitation were not derived from soil or crustal material. Cadmium, Cu, and Pb were enriched in all samples of bulk precipitation relative to their abundances in local soils, and were most enriched during autumn and winter. A multiple regression procedure suggested that wetfall was the primary mode of aerial deposition of Ce and Cu, whereas both wetfall and dryfall were important modes of aerial deposition of Pb.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 28513, 28931, 29587, 29618, 29725

29601 (DOE/NV/00410—60) **Environmental surveillance report for the Nevada Test Site, January-December 1979.** Lantz, M.W. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Jun 1980. Contract AC08-76NV00410. 166p. NTIS, PC A08/MF A01.

The environmental surveillance program at the Nevada Test Site as conducted by the Department of Energy (DOE) onsite radiological safety contractor is documented from January 1979 through December 1979. The results and evaluations of measurements of radioactivity in air and water, and of direct gamma radiation exposure rates are presented. Relevancy to DOE concentration guides (CG'S) is established.

29602 (DP-MS—79-76) **Evaluation of a modified Gaussian plume model for travel distances 25 to 150 KM.** Huang, J.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.).

1980. Contract AC09-76SR00001. 18p. (CONF-800327—13). NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

Gaussian plume model was developed and evaluated using observed Kr-85 air concentration data. The main features of the model include: segmented plumes and displaced effective source terms; reflective upper and lower boundaries; and formulations describing the effects of time-varying mixing height. The model was evaluated in terms of goodness factor, root mean square error, percentage of hits, and percentage of observed and calculated concentrations within a factor of 2 and 10. The test results show that this model predicts observed concentrations fairly well and is superior to the simpler wind rose and segmented plume models. Moreover, the prediction capability of the modified Gaussian model is also found to be insensitive to plume travel distances up to 150 kilometers.

29603 (MLM—2703(OP)) **Development of a radon monitoring plan for Canonsburg, Pennsylvania.** Yates, W.G.; Jenkins, P.H. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract EY-76-C-04-0053. 4p. (CONF-800334—9). NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The site of the former Vitro Rare Metals Plant, now called the Canon Industrial Park, has been found to be contaminated with large quantities of radioactive wastes generated during former radium and uranium recovery operations. This report describes the development of a comprehensive radon monitoring program in the environment surrounding the site. (ACR)

29604 (RFP—2921) **Catalogue of monitoring activities at Rocky Flats: 1978, 1979.** Werkema, M.V. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 20 Jun 1980. Contract AC04-76DP03533. 67p. NTIS, PC A04/MF A01.

A listing of environmental surveillance sampling endeavors for the years 1978 and 1979 is given in which sampling media, i.e., ambient air, stack effluent air, water, and soil are considered. Sampling locations, frequency of sampling, parameters analyzed, and control limits also are given. The objectives of the sampling are considered in defining the program.

29605 (UCRL—83294) **Correlation between predicted and observed levels of airborne tritium at Lawrence Livermore Laboratory site boundary.** Lindeken, C.L.; Silver, W.J.; Toy, A.J.; White, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1980. Contract W-7405-ENG-48. 10p. (CONF-800586—1). NTIS, PC A02/MF A01.

From ANS topical meeting; Dayton, OH, USA (1 May 1980).

At the Lawrence Livermore Laboratory, a computer code based on the Gaussian plume model is used to estimate radiation doses from routine or accidental release of airborne radioactive material. Routine releases of tritium have been used as a test of the overall uncertainty associated with these estimates. The ration of concentration to release rate at distances from the two principal release points to each of six site boundary sampling locations has been calcuated using local meteorological data. The concentration of airborne tritiated water vapor is continuously measured at the six sampling stations as part of the Laboratory's environmental monitoring program. Comparison of predicted with observed annual tritiated water concentrations in 1978 showed an average ratio of 2.6 with a range of from 0.97 to 5.8.

29606 **Environmental sources of radon.** Travis, C.C. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 144-145(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29607 **Radon-222 in energy-efficient buildings.** Hollowell, C.D.; Boegel, M.L.; Ingersoll, J.G.; Nazaroff, W.W. (Univ. of California, Berkeley). *Trans. Am. Nucl. Soc.;* **33**: 148-150(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29608 **Radon sources, distributions, and exposures in residential buildings.** Breslin, A.J.; George, A.C. (Environmental Measurements Lab., New York, NY). *Trans. Am. Nucl. Soc.;* **33**: 150-152(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29609 **Evaluation of uncertainties in selected environmental dispersion models.** Little, C.A.; Miller, C.W. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 176(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29610 **Analytical study of virtual impactor aerosol separators.** Hassan, Y.A. (Univ. of Illinois, Urbana); Jones, B.G.; Yule, T.J. *Trans. Am. Nucl. Soc.;* **33**: 182-184(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29611 **Evaluation of methods for analyzing environmental TLD measurements at nuclear facilities.** de Planque, G. (Environmental Measurements Lab., New York, NY). *Trans. Am. Nucl. Soc.;* **33**: 188-189(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29612 **Dispersion parameters: impact on calculated reactor accident consequences.** Aldrich, D.C. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 200-202(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 28925, 28926, 28930, 28931

SITE RESOURCE AND USE STUDIES

29613 (ORNL/HUD/MIUS—52) **Environmental assessment of air quality, noise and cooling tower drift from the Jersey City Total Energy Demonstration.** Davis, W.T.; Kolb, J.O. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 145p. NTIS, PC A07/MF A01.

This assessment covers three specific effects from the operation of the Total Energy (TE) demonstration: (1) air quality from combustion emissions of 600 kW diesel engines and auxiliary boilers fueled with No. 2 distillate oil, (2) noise levels from TE equipment operation, (3) cooling tower drift from two, 2220 gpm, forced-draft cooling towers. For the air quality study, measurements were performed to determine both the combustion emission rates and ground-level air quality at the Demonstration site. Stack analysis of NO/sub x/, SO_2, CO, particulates, and total hydrocarbons characterized emission rates over a range of operating conditions. Ground-level air quality was monitored during two six-week periods during the summer and winter of 1977. The noise study was performed by measuring sound levels in db(A) in the area within approximately 60 m of the CEB. The noise survey investigated the effects on noise distribution of different wind conditions, time of day or night, and condition of doors - open or closed - near the diesel engines in the CEB. In the cooling tower study, drift emission characteristics were measured to quantify the drift emission before and after cleaning of the tower internals to reduce fallout of large drift droplets in the vicinity of the CEB.

REGULATIONS

REFER ALSO TO CITATION(S) 28338, 28754, 29584

ENVIRONMENTAL SCIENCES, TERRESTRIAL

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 29396

29614 (CONF-800643—1) **Concentration of stable elements in food products.** Montford, M.A.; Shank, K.E.; Hendricks, C.; Oakes, T.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From 14. annual conference on trace substances in environmental health; Columbia, MO, USA (2 Jun 1980).

Food samples were taken from commercial markets and analyzed for stable element content. The concentrations of most stable elements (Ag, Al, As, Au, Ba, Br, Ca, Ce, Cl, Co, Cr, Cs, Cu, Fe, Hf, I, K, La, Mg, Mn, Mo, Na, Rb, Sb, Sc, Se, Sr, Ta, Th, Ti, V, Zn, Zr) were determined using multiple-element neutron activation analysis, while the concentrations of other elements (Cd, Hg, Ni, Pb) were determined using atomic absorption. The relevance of the concentrations found are noted in relation to other literature values. An earlier study was extended to include the determination of the concentration of stable elements in home-grown products in the

vicinity of the Oak Ridge National Laboratory. Comparisons between the commercial and local food-stuff values are discussed.

29615 Soil ingestion by mule deer in northcentral Colorado. Arthur, W.J. III; Alldredge, A.W. (Idaho National Engineering Lab., Idaho Falls). Contract E(11-1)-1156. *J. Range Manage.;* **32**: No. 1, 67-71(Jan 1979).

soil ingestion rates calcuated from titanium concentrations in feces from mule deer (Odocoileus hemionus) feeding in a grass-land-shrub community in northcentral Colorado in g/day (anti x +- SD) were: spring, 29.6 +- 20.1; summer, 7.7 +- 10.2; fall, 8.8 +- 6.5; and winter 18.3 +- 10.8. Based on observations of feeding tame deer, intake in winter appeared to be primarily due to direct soil ingestion from pocket gopher (Thomomys talpoides) mounds, roads, and other areas of exposed soil. The greatest intake during spring was likely due to indirect consumption of soil adhering to ingested vegetation. Soils from locations where tame deer had consumed soil were analyzed for trace elements (Ca, Cu, Fe, Mg, Mn, P, K, Na, and Zn) and compared to areas where no soil intake was observed. No significant differences ($\alpha = 0.05$) in mean levels of these elements was detected between areas. Most likely, deer at Rocky Flats were not selecting soils based strictly on mineral content, but instead were consuming soil indiscriminately. Ingested soil may provide a source of trace elements as well as a mode of entry for environmental pollutants.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 29609

SOIL

REFER ALSO TO CITATION(S) 28423, 28495, 28498, 28508, 28509, 28514, 28515, 28518, 29601, 29604

29616 (CONF-800820—4) **Statistical analysis of radioactivity in the environment.** Barnes, M.G.; Giacomini, J.J. (Nevada Univ., Reno (USA). Center for Water Resources Research). May 1980. Contract AC08-76DP01253. 21p. NTIS, PC A02/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

The pattern of radioactivity in surface soils of Area 5 of the Nevada Test Site is analyzed statistically by means of kriging. The 1962 event code-named Smallboy effected the greatest proportion of the area sampled, but some of the area was also affected by a number of other events. The data for this study were collected on a regular grid to take advantage of the efficiency of grid sampling. (ACR)

29617 (ORO—4700) **Dissolution and transport of plutonium from oxide particles in soils.** Brown, D.A. (Arkansas Univ., Fayetteville (USA). Dept. of Agronomy). 1978. Contract AS05-76EV04700. 34p. NTIS, PC A03/MF A01.

This report contains a summary of methods and data on plutonium dissolution and movement in four soils, plus a copy of a manuscript describing the automatic sample changer for alpha radiation detection which has been submitted for publication. (PCS)

29618 Radon from radium-bearing residues: how does it get here to there. Goldsmith, W.A. (Oak Ridge National Lab., TN); Clements, W.E. *Trans. Am. Nucl. Soc.;* **33**: 147-148(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29619 Characteristics of plutonium significant in migration studies. Tamura, T.; Lee, S.Y. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 164(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 29721, 29725

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 28422, 28493, 28494, 28498, 28501, 29203, 29707

29620 (ORNL/TM—6813) **Ecological analysis of the US Forest Service's RARE-II sites.** Klopatek, J.M.; Kitchings, J.T.; Olson, R.J.; Kumar, K.D.; Mann, L.K. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 240p. NTIS, PC A11/MF A01.

A methodology has been developed and applied to measure the ecological quality of land areas being evaluated as potential wilderness areas under the US Department of Agriculture (USDA) Forest Service's Roadless Area Review and Evaluation (RARE-II) Program. Four major parameters were chosen to quantify land areas located anywhere in the conterminous United States. These are: (1) vegetation - the principal vegetation communities within each area; (2) avian communities - the kinds and abundance of birds inhabiting an area and the quality of habitat provided by an area; (3) mammal communities - the species of mammals inhabiting an area; and (4) endangered or threatened species - the occurrence of species and whether or not the area provides critical habitat. The results are shown for the Douglas-fir ecoregion of the United States and are used in a conflict matrix to segregate identified tracts according to their ecological ratings and energy and mineral resource ratings.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 28339, 29576, 29583, 29685, 29694

29621 (DOE/EV/00901—T1) **Coordination: southeast continental shelf studies. Progress report.** Menzel, D.W. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Mar 1980. Contract AS09-76EV00901. 30p. NTIS, PC A03/MF A01.

The GABEX I experiment is designed to provide synoptic coverage of a series of Gulf Stream wave-like disturbances, the effect of these on the circulation of the entire shelf, and on biological and chemical processes. This study was initiated in February 1980 when current meter arrays were deployed. These meters will be removed in July 1980. In April three ships will simultaneously study the effects of Gulf Stream disturbances on the hydrography, chemistry, and biology of the shelf. One vessel will track a specific wave-like disturbance and provide synoptic coverage of the shelf area. The second vessel will determine the effect of shelf break processes on adjacent shelf water; and the third will study trace metal distributions in and outside of disturbances. Research progress is reported in continental shelf studies, nearshore and estuarine studies (diffusion of freshwater out of nearshore zone), tidal currents and material transport, and mixing of inlet plumes.

29622 (DOE/EV/00936—T1) **Ocean chlorophyll studies from a U-2 aircraft platform.** Kim, H.H.; McClain, C.R.; Blaine, L.R.; Hart, W.D.; Atkinson, L.P.; Yoder, J.A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1979. Contract AS09-76EV00936. 37p. NTIS, PC A03/MF A01.

Chlorophyll gradient maps of large ocean areas were generated from U2/OCS data obtained over test sites in the Pacific and Atlantic Oceans. The delineation of oceanic features using the upward radiant intensity relies on an analysis method which presupposes that radiation backscattered from the atmosphere and ocean surface can be properly modeled using a measurement made at 778 nm. The calculation of atmospheric radiance was performed using a method developed by J.V. Dave. An estimation of the chlorophyll concentration is performed by properly ratioing radiances measured at 472 nm and 548 nm after removing the atmospheric effects. The correlation between the remotely sensed data and in-situ surface chlorophyll measurements has been validated in two sets of data. The results show that the correlation between the in-situ measured chlorophyll and the derived quantity is a negative exponential function and the correlation was calculated to be -0.965.

29623 (DOE/EV/00936—T2) **Biological processes in the water column of the South Atlantic bight.** Paffenhoefer, G.A.; Yoder, J.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 31 Jan 1980. Contract AS09-76EV00936. 209p. NTIS, PC A10/MF A01.

Progress is reported on research conducted during 1979 on the biological oceanography of the South Atlantic Bight. The presentation consists of a number of published articles and abstracts of oral presentations. (ACR)

29624 Long-term global sea surface temperature fluctuations and their possible influence on atmospheric CO_2 concentrations. Newell, R.E.; Navato, A.r.; Hsiung, J. (Massachusetts Inst. of Tech., Cambridge). *Pageoph;* **116**: 351-371(1978).

Changes of atmospheric CO_2 concentration since 1958 are shown to be related to sea surface temperature changes. The largest contribution to changes arises from the Pacific equatorial upwelling region, with the Indian Ocean and Atlantic contributing only small

fractions to the variance. It is hypothesized that the observed relationship is related to the nutrients that are brought up by upwelling cold water, with photosynthesis contributing to a lowering of the partial pressure of CO_2 in the sea and thus to a greater tendency for a flux from the air to the sea. Possible longer term variations of sea temperature and CO_2 are discussed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 28301, 28395, 28639, 29585, 29600, 29685, 29748

29625 (EPRI-CS—1355) **Modeling the fixed FGD sludge landfill, Conesville, Ohio, Phase 1.** Bond, F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 125p. NTIS, PC A06/MF A01.

A full-scale application of IU Conversion Systems, Inc. fixation process for treating flue gas desulfurization (FGD) sludge is in operation at the Conesville Power Station of the Columbus and Southern Ohio Electric Company. The leaching and potential groundwater contamination aspects of FGD sludge disposal at the Conesville site were studied in some detail to provide information useful to utilities making decisions regarding the disposal of FGD sludge. This report documents the first phase of a two-phase study. Phase I entails data collection and model preparation, whereas Phase II will include extensive field monitoring, model application, and a final assessment. In Phase I, a model data base was formulated and laboratory studies were conducted to determine saturated and partially-saturated permeabilities of sludge and ash materials, and to describe the composition and distribution of the sludge and ash leachate. The data base and laboratory results were used to implement, calibrate, and verify a two-dimensional, finite difference, hydrologic flow model for the study area. The model output was coupled with a technique of graphing contaminant arrival distribution to predict the distribution in time and space of contaminants traveling with the groundwater within the study area.

29626 (ORNL/TM—6328/V1) **Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.** Pitt, W.W. Jr.; Mrochek, J.E. (comps.). (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 278p. NTIS, PC A13/MF A01.

Research efforts in six areas are reported. They include: centrifugal analyzer development; advanced analytical systems; environmental research; bioengineering research;bioprocess development and demonstration; and, environmental control technology. Individual abstracts were prepared for each section for ERA/EDB. (JCB)

29627 (ORNL/TM—6328/V1, pp 78-150) **Environmental research.** Pitt, W.W. Jr.; Denton, M.S.; Jolley, R.L.; Schuresko, D.E.; Hartmann, S.J.; Jones, G. Jr.; Thompson, J.E. Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

Environmental research efforts are reported in four areas: identification of dissolved organics in polluted waters; environmental effects of antifoulants; chemical effects of disinfectants; and environmental monitoring. Pollutant identification, data processing, and mass spectra interpretation were greatly facilitated by the installation of a Systems Industries System 150 to accumulate and process data from the Finnigan 3000 mass spectrometer. The use of a computer to collect and massage the data from the GC/MS will permit examination of mass spectra for specific indicator masses and assist in evaluation and elimination of background or noise peaks. Reconstructed gas chromatogram and mass spectra printouts will provide permanent records of mass spectral analyses. To complement anion exchange separations on aqueous effluents from coal hydrocarbonization bench-scale experiments, a trace enrichment method using reverse-phase chromatography has been initiated. The trihalomethanes, chloroform, bromodichloromethane, and dibromochloromethane are formed during the chlorination of cooling waters from both once-through and closed-cycle (cooling towers) systems. Based on values determined at the local industrial sites, the local production of the carcinogen chloroform is in excess of a ton per year. Equipment for laboratory uv irradiation of wastewater effluents was assembled to allow the comparison of the chemical effects of uv irradiation, ozonation, and chlorination. Several wastewater samples were collected and processed for chemical and mutagenic studies, and collection of field samples was initiated. The development of a multicellular scintillation counter for use in environmental monitoring of ultralow concentrations (less than 1 nCi/ml) of radioactive pollutants in aqueous streams was begun.

29628 (ORNL/TM—6328/V1, pp 187-260) **Bioprocess development and demonstration.** Pitt, W.W. Jr. Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

Bioprocess development and demonstration activites during this report period included the operation of bench-scale and pilot-plant ANFLOW (anaerobic upflow system for treatment of wastewater) units and long-term operation of a large fluidized-bed denitrification bioreactor. The ANFLOW demonstration pilot plant was operated essentially continuously at feed rates up to 15.1 m^3/day (4000 gal/day) with steadily improving performance. The bench-scale unit was also operated under conditions similar to the pilot plant, using raw sewage as feed. Results for the smaller unit compared closely with those from the large unit except for a much greater rate of methane production by the smaller unit. A preliminary cost estimate comparing ANFLOW with conventional waste treatment indicated that for waste treatment plants, 1 million gallon per day or less in size, the capital costs of ANFLOW would be less and consume much less energy than would conventional methods. Progress is also reported on research on the biological denitrification of various nitrate-containing waste streams associated with the nuclear industry, namely, evaluating the influence of radiation and the concentrations of sodium, calcium, nitrate, ammonium, and nickel on denitrification rates.

29629 (ORNL/TM—6328/V1, pp 261-268) **Environmental control technology: assessment of environmental control technology for hydrocarbonization.** Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

The available and potential technologies for environmental control of the aqueous wastes from the hydrocarbonization process for coal liquefaction are being assessed. It has been concluded that the aqueous contaminants of most concern are phenolics, trace elements, and polycyclic aromatic hydrocarbons and that these groups will have the greatest impact on the types of control technologies used. Efforts during this report period have concentrated on six wastewater treatment methods, assessing their applicability for treating hydrocarbonization wastewater. The assessment led to several screening tests, including removal of polycyclic aromatic hydrocarbons with charcoal and polymeric resins and phenol removal with hydrocarbonization char. In addition, the tapered fluidized-bed bioreactor was operated on actual coal hydrocarbonization wastewater, effectively reducing the phenol level to less than 1 ppM.

29630 **Precipitation acidity: the role of the forest canopy in acid exchange.** Hoffman, W.A., Jr.; Lindberg, S.E.; Turner, R.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Qual.;* 9: No. 1, 95-100(Jan 1980).

Individual rain events were sampled above and below the forest canopy in Walker Branch Watershed, Tennessee, from August 1977 to June 1978 for the purpose of analysis of acidity and organic content. Strong acid content correlated with sulfate concentrations. Total acid concentrations were conserved as rain penetrated chestnut oak (Quercus prinus L.) canopies, although the strong/weak acid ratio declined substantially. Although weak acids constituted at least 30% of the total acidity of incident rain and increased to over 50% in throughfall, the increase could not be entirely attributed to organic acids. The results of the study support the fundamental importance of iron-exchange models in systematizing rain-vegetation interactions.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 29609

WATER

REFER ALSO TO CITATION(S) 28497, 28499, 28516, 28527, 29604, 29628

29631 **Non-Fickian dispersive transport of chain-decayed radiocontaminants in a groundwater system.** Simmons, C.S. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* 33: 198-199(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 29725

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 29636

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 28336

29632 (DOE/EV/00889—T1) **Continental shelf processes affecting the oceanography of the South Atlantic Bight. Progress report, 1 June 1979-31 May 1980.** Atkinson, L.P. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 29 Feb 1980. Contract AS09-76EV00889. 14p. NTIS, PC A02/MF A01.

The papers included in this progress report summarize some significant developments in understanding the South Atlantic Bight. Some of the results are summarized as follows: Onslow Bay flushing rates can be determined using a model based on an exponential dilution model; eddy induced nitrate flux accounts for most input of new nitrogen into shelf waters; and tarballs in the Gulf Stream are not transported to the nearshore because of an apparent inner shelf density front.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 29167, 29206

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 28411, 28517, 29171, 29198, 29202, 29635

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 28517, 29191, 29194

ENVIRONMENTAL IMPACT STATEMENTS

29633 (DOE/EIS—0064(Vol.2)) **Final environmental impact statement (final statement to ERDA 1545-D): Rocky Flats Plant Site, Golden, Jefferson County, Colorado. Volume 2. Appendices.** (Department of Energy, Washington, DC (USA)). Apr 1980. 399p. NTIS, PC E10/MF E10.

Appendix A consists of two parts. The first is a composite listing of Rocky Flats flora and faun generated by on-site and off-site researchers. The second document, is a reproduction of a three-year summary report of Colorado State University researchers.

29634 (DOE/EIS—0064(Vol.3)) **Final environmental impact statement (final statement to ERDA 1545-D): Rocky Flats Plant Site, Golden, Jefferson County, Colorado. Volume 3. Responses to public comments.** (Department of Energy, Washington, DC (USA)). Apr 1980. 473p. NTIS, PC E10/MF E10.

Comment letters have been reviewed and appropriate additions and corrections have been made. (PCS)

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 29743, 29755

29635 (LA—8284-MS) **Rural migration in the western states.** Freiwald, J.G.; Poster, B.R.; Olinger, C.; Aragon, P.C.; Buslee, P.L. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 102p. NTIS, PC A06/MF A01.

The rapid rural growth rate since 1970 in 14 western states (Arizona, Colorado, Kansas, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming) was stimulated by recreation, resource development, manufacturing, commuting, institutional employment, and retirement. The eight Rocky Mountain States had significantly greater rural growth than the six Great Plains States. Other factors correlated with in-migration are population growth during the 1960's, presence of an interstate highway, adjacency to a metropolitan area, high per capita income, high population density, and absence of rural farm population. The presence of a central city with a population of over 20,000 or of a military base does not appear to be significantly related to net in-migration. An overview of regional growth patterns and of the factors related to rural in-migration is included, followed by an examination of these factors for each of the counties that experienced high in-migration in the 14 states.

29636 **Temperatures occupied by ten ultrasonic-tagged striped bass in freshwater lakes.** Coutant, C.C.; Carroll, D.S. (Oak Ridge National Lab., TN). *Trans. Am. Fish. Soc.;* **109**: No. 2, 195-202(Mar 1980).

Subadult striped bass, Morone saxatilis, tagged with temperature-sensing ultrasonic transmitters in April-October and monitored in freshwater lakes generally occupied waters of 20 to 24°C, when these temperatures were available. When they were not (spring and fall), fish occupied nearly the warmest water available at depths > 1.5 m. Excursions of less than 2 minutes duration to warmer and to cooler water than was generally occupied were common in spring and summer. A thermal niche for subadult striped bass of 20 to 24°C centering near 22°C, as suggested by these results, would have important implications for managing this species in fresh water.

29637 **Cancer incidence by marital status: U.S. Third National Cancer Survey.** Ernster, V.L. (Univ. of California, San Francisco); Sacks, S.T.; Selvin, S.; Petrakis, N.L. *J. Natl. Cancer Inst.;* **63**: No. 3, 567-585(Sep 1979).

Site-specific cancer incidence rats were computed by sex, age, and marital status for whites and blacks separately for ages 35-64 years with the use of population-based incidence data from the Third National Cancer Survey (1969-71) and with demographic data from the 1970 U.S. Census. Although rates were presented for all cancer sites combined and for 44 specific sites or rubrics, discussion focused on the 17 most common cancers. Within age, race, and sex groups, patterns of cancer incidence by marital status were compared by means of standardized incidence ratios, and the consistency of marital status patterns across age groups was assessed statistically. Among the most notable findings were: excess cancer rates across most sites and age groups in single black males, consistently high rates for cancer of the lung and bronchus in divorced white males and in single black females, low rates for the hormone-dependent reproductive tumors (prostate gland, breast, uterine corpus, and ovary) in separated white males and females, and high rates for cervical cancer among separated white women. Marital status patterns, where found, frequently differed between whites and blacks and between males and females.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 29667

29638 **Senescence in fishes.** Woodhead, A.D. (Brookhaven National Lab., Upton, NY). *Symp. Zool. Soc. London;* No. 44, 179-205(1979).

A long-standing theory, that there is a fundamental difference in aging between fishes and higher vertebrates, is still alive in the minds of many. In 1932, Bidder proposed that aging was causatively related to the cessation of growth at sexual maturity. Fish, which continue to grow throughout their lives, would not age, and therefore were potentially immortal. His ideas were clearly disproven by Comfort, who established that the survival curves of a laboratory population of guppies, Poecilia reticulata, were very similar to those of a small mammal population under laboratory conditions. Recent data from field and laboratory studies, including histological evidence, amply confirm the occurrence of senescence in fishes. Natural death in fish has been associated with reproduction. There is good evidence for a number of species which shows that, with increasing size, the gonad forms a greater proportion of total body weight. In older, larger fish, extensive energy depletion for reproduction is suggested as an important factor in mortality. Reproductive modifications in older fish are also noted.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 28564, 29615, 29626, 29668, 29670, 29672, 29680, 29681, 29682, 29683, 29693, 29694, 29695, 29700, 29701, 29704, 29705, 29711, 29712, 29713, 29716, 29717, 29718, 29722, 29735, 29736, 29737

29639 (CONF-800239—1) **Restricted infectivity of ecotropic type C retroviruses in mouse teratocarcinoma cells: studies on viral DNA intermediates.** Yang, W.K.; d'Auriol, L.; Yang, D.M.; Kiggans, J.O. Jr.; Ou, C.Y.; Peries, J.; Emanoil-Ravicovitch, R. (Oak Ridge National Lab., TN (USA); Hopital Saint-Louis, 75 - Paris (France)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From ICN-UCLA symposium; Keystone, CO, USA (17 Feb 1980).

Infectivity of retroviruses in cultured murine teratocarcinoma cells was found to be affected by the state of cellular differentiation. Present studies utilize two kinds of cell cultures from teratocarcinomas of mouse strain 129, an undifferentiated pluriopotential cell line (PCC_4) and a myoblast-derived cell line (PCD_1) which are respectively resistant and susceptible to the infection of Gross strain N-tropic type C retrovirus. Analyses of the appearance of free viral DNA intermediates in these cells from 4 to 78 h after virus inoculation were made. In both PCD_1 and PCC_4 cells, virus inoculation induced the formation of one linear form (III) and two covalently-closed supercoiled circular forms (I) of viral DNA duplexes; the linear form showing its appearance, increase, and decline in the 4 to 18 h period, and the circular forms in the 8 to 24 h period. In the period of 56 to 78 h after virus inoculation, a secondary burst of viral DNA synthesis occurred in PCD_1 cells, whereas both linear and supercoiled viral DNA duplexes became undetectable in PCC_4 cells. Free and unintegrated viral DNA preparations from PCD_1 and PCC_4 cells 10 h after virus inoculation were both infectious for N3T3 cells in a DNA transfection assay. Both PCD_1 and PCC_4 cells were very poor recipients for DNA transfection. These results indicate that restriction of retrovirus in undifferentiated teratocarcinoma cells occurs at a step beyond formation and maturation of viral DNA intermediates. (ERB)

29640 (CONF-800351—2) **In vitro packaging of damaged bacteriophage T7 DNA.** Masker, W.E.; Kuemmerle, N.B.; Dodson, L.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

From Symposium on DNA-multiprotein interactions in transcription, replication, and repair; Gatlinburg, TN, USA (24 Mar 1980).

Experiments using in vitro packaging to monitor the biological activity of DNA recovered after in vitro repair, replication, and recombination reactions are described. These results suggest that the in vitro systems mimic the in vivo situation sufficiently well to allow generation (or restoration) of DNA molecules which can be encapsulated to form fully viable T7 phage particles. The in vitro packaging system has proved to be a convenient and relatively sensitive means for determining the amount of biological damage present in T7 DNA and for examining the response of various DNA metabolic systems to that damage.

29641 (LBL—10947) **Control of T4 gene 32 helix-destabilizing protein activity in a DNA replication complex.** Hosoda, J.; Burke, R.L.; Moise, H.; Kubota, I.; Tsugita, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 11p. (CONF-800385—1). NTIS, PC A02/MF A01.

From ICN-UCLA symposia on molecular and cellular biology; Keystone, CO, USA (16 Mar 1980).

$32^{*}I$ protein is produced by the chymotryptic cleavage of the A domain ($\simeq$ 60 amino acid residues) from the carboxyl terminus of T4 gene 32 protein. The amino acid sequence of the A domain, and the effects of its removal on the physicochemical properties of 32 protein are reported. We have substituted $32^{*}I$ protein for the intact protein in a variety of in vitro DNA replication reactions to probe the roles of the A domain in DNA replication.

29642 (ORNL/TM—6328/V1, pp 1-51) **Centrifugal analyzer development.** Bauer, M.L.; Bostick, W.D.; Cumming, R.B.; Genung, R.K.; Jackson, J.; Overton, J.B.; Mrochek, J.E. Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

Development efforts on the centrifugal analyzer concept have centered on the portable Centrifugal Fast Analyzer (CFA) and on applications which take advantage of the centrifugal analyzer's unique capabilities and versatility. During the reporting period, emphasis was on the reduction of electronic noise and improvement of temperature control. Additional software capabilities were added to the microcomputer, and the first production model was delivered. Application studies resulted in the development of an enzyme amplification reaction which yielded a part-per-billion sensitivity to high-energy phosphates and a kinetic assay which, with the CFA's capability for a high-sample throughput, helped map a structural gene on a mouse chromosome.

29643 (ORNL/TM—6328/V1, pp 52-77) **Advanced analytical systems.** Mrochek, J.E. Jun 1980.

In Advanced Technology Section semiannual progress report, April 1-September 30, 1977. Volume 1. Biotechnology and environmental programs.

Development efforts in advanced analytical systems were concentrated in two areas: application of high-resolution liquid chromatography (HRLC) to the measurement of enzyme activity, and a new concept for automated gel electrophoresis. The application of HRLC to measurement of enzyme activity, as illustrated by the separation and assay of arylsulfatase isoenzymes developed during this report period, has a potential for improved clinical diagnostic procedures for noninvasive diagnosis of organic damage and disease. An automated gel electrophoresis system which has the potential for a large sample throughput yielding additional data for recognizing mutant proteins was conceptualized and its feasibility established.

29644 Mechanism of linolenic acid-induced inhibition of photosynthetic electron transport. Golbeck, J.H.; Martin, I.F.; Fowler, C.F. (Martin Marietta Labs., Baltimore, MD). *Plant Physiol.;* **65**: No. 4, 707-713(Apr 1980).

The effect of linolenic acid on photosynthetic electron transport reactions in chloroplasts has been localized at a site on the donor side of photosystem I and at two functionally distinct sites in photosystem II. In photosystem I, an increase in the electron transport rate occurs in the presence of 10 to 100 micromolar linolenic acid, followed by a decline in rate from 100 to 200 micromolar linolenic acid. The increase may result from an alteration of membrane structure that allows greater reactivity of the artificial donors with plastocyanin. The decrease is due to loss of plastocyanin from the membrane. In photosystem II, reversible site and an irreversible site of inhibiton have been located. At the irreversible site, there is a time-dependent loss of the loosely bound pool of Mn implicated in the water-splitting mechanism. At the reversible site, the photochemical charge separation is rapidly inhibited. This reversible inhibition of the photoact is a unique characteristic of linolenic acid and suggests evidence for a new mode of inhibition of photosystem II.

29645 Light-driven uptake of oxygen, carbon dioxide, and bicarbonate by the green alga Scenedesmus. Radmer, R.; Ollinger, O. (Martin Marietta Labs., Baltimore, MD). Contract EY-76-C-02-3326. *Plant Physiol.;* **65**: No. 4, 723-729(Apr 1980).

The hypothesis that air-grown Scenedesmus can assimilate HCO_3^- by directly monitoring the time course of dissolved CO_2, O_2 uptake, and O_2 evolution in illuminated algal suspensions at alkaline pH was tested. Inasmuch as the measuring technique employed was fast compared to the nonenzymic equilibration of the ionorganic carbon species, it was possible to determine the degree to which the CO_2 concentration deviated from equilibrium (with the other inorganic carbon species) during the course of illumination. The observed kinetics in air-grown and CO_2-grown algae in the presence and absence of carbonic anhydrase, and a comparison of these kinetics with theoretical (computer-generated) time courses, support the idea that air-adapted algae are able to assimilate HCO_3^- actively at a high rate. The data suggest that these algae preferentially assimilate CO_2 and supply the balance of their needs by taking up HCO_3^-. Since (unlike C_4 plants) these algae have no special CO_2 pump, and thus have a relatively low affinity for CO_2, HCO_3^- assimilation is the major carbon uptake process at alkaline pH even when the total CO_2 is present in millimolar concentrations.

29646 Catecholamine regulation of lactate dehydrogenase in rat brain cell culture. Kumar, S.; McGinnis, J.F.; de Vellis, J. (Univ. of California, Los Angeles). *J. Biol. Chem.;* **255**: No. 6, 2315-2321(25 Mar 1980).

The mechanism of catecholamine induction of the soluble cytoplasmic enzyme lactate dehydrogenase (EC 1.1.1.27) was studied in the rat glial tumor cell line, C6. Lactate dehydrogenase was partially purified from extracts of [^{3}H]leucine-labeled cells by affinity gel chromatography and quantitatively immunoprecipitated with anti-lactate dehydrogenase-5 IgG and with antilactate dehydrogenase-1 IgG. The immunoprecipitates were dissociated and electrophoresed on sodium dodecyl sulfate polyacrylamide gels. Using this methodology, the increased enzyme activity of lactate dehydrogenase in norepinephrine-treated C6 cells was observed to be concomitant with the increased synthesis of enzyme molecules. Despite the continued presence of norepinephrine, the specific increase in the rate of synthesis of lactate dehydrogenase was transient. It was first detected at 4 h, was maximum at 9 h, and returned to basal levels by 24 h. The half-life of lactate dehydrogenase enzyme activity was 36 h during the induction and 40 h during deinduction. The half-life for decay of ^{3}H-labeled lactate dehydrogenase was 41 h. These observations suggest that the increase in lactate dehydrogenase activity in norepinephrine-treated cells does not involve any change in the rate of degradation. Norepinephrine increased the specific rate of synthesis of both lactate dehydrogenase-5 (a tetramer of four M subunits) and lactate dehydrogenase-1 (a tetramer of four H subunits), although to different extents. Since these subunits are coded for by two separate genes on separate chromosomes, it suggests that the regulatory mechanism involves at least two separate sites of action.

29647 Models of siroheme and sirohydrochlorin. π cation radicals of iron(II) isobacteriochlorin. Chang, C.K. (Michigan State Univ., East Lansing); Fajer, J. Contract EY-76-C-02-0016. *J. Am. Chem. Soc.;* **102**: No. 2, 848-851(16 Jan 1980).

Due to the difficulties associated with obtaining the quantities of microbial siroheme needed for extensive studies, preparation of a synthetic iron complex of the isobacteriochlorin family reported here is noteworthy. Hydrogen peroxide reacted with octaethylporphyrin in 82% H_2SO_4 at 10°C using excess H_2O_2 resulted in an

overall yield of the porphyrin diketones in excess of 20%. The gemini-diketoporphyrin isolated by chromatography was converted to the methylated isobacteriochlorin by reaction with methyl lithium followed by hydrolysis. Reduction of the resultant tertiary alcohols yielded diasteric isomers of 2,4-dimethyl-gemini-octaethylisobacteriochlorin (I) which could not be separated by liquid chromatography. Reaction of this compound with ferrous perchlorate in pyridine-acetic acid medium under argon yielded, almost quantitatively, the violet pyridine hemechrome. Voltammetry, controlled potential coulometry, and EPR were used to examine the redox chemistry of I. Results indicated that the reacting species are π cation radicals and that facile oxidation of the isobacteriochlorins di tates the choice of electron pathway involving the π system in sulfite and nitrite reduction. (BLM)

29648 Potassium chloride as stomatal osmoticum in Allium cepa L., a species devoid of starch in guard cells. Schnabl, H.; Raschke, K. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiol.;* **65**: No. 1, 88-93(Jan 1980).

KCl was, in general, the major osmoticum in guard cells, irrespective of whether stomata had opened on leaves or in epidermal strips floating on solutions. The solute requirement varied between 50 and 110 femtomoles KCl per micrometer increase in aperture per pair of guard cells. Stomata did not open on solutions of K iminodiacetate, presumably because its anion could not be taken up. Stomata opened if KCl or KBr was provided. Taken together, the results indicate that the absence of starch from guard cells deprived them of the ability to produce malate in amounts of osmotic consequence and that the presence of absorbable Cl^- (or Br^-) was necessary for stomatal opening. Previous nutrient supply of the plants determined whether the charges of K^+ in guard cells were completely balanced by Cl^- or only partially. Addition of K_2SO_4 to the nutrient solution reduced the participation of Cl^- in stomatal ion transfer, even if epidermal strips of these plants were later exposed to KCl solution. Although malate appeared not to participate in stomatal ion transfer in onion, epidermal samples of this species did contain malate. Malate accumulated in the epidermis of leaves put into the light but disappeared from illuminated epidermal strips floating on solutions. In whole leaves, epidermal malate content was positively correlated with stomatal opening; in epidermal strips floating on solutions, the correlation was negative or absent.

29649 Kinetics and time dependence of the effect of far red light on the photoperiodic induction of flowering in Wintex barley. Deitzer, G.F.; Hayes, R.; Jabben, M. (Radiation Biology Lab., Rockville, MD). *Plant Physiol.;* **64**: No. 6, 1015-1021(Dec 1979).

Flowering in the long day plant Hordeum vulgare L. var. Wintex barley was enhanced by the addition of far red light to the main light portion of the photoperiod. Far red energy was provided to produce quantum flux ratios (600/730 nm) and phytochrome photoequilibria (Pfr/total phytochrome) equivalent to those reported both beneath a leaf canopy and outside a canopy at twilight. The photoperiodic requirement for long days can be completely eliminated by the addition of far red light. However, both the effect of extending the photoperiod without far red and the addition of far red to 12-hour photoperiods were suboptimal. Maximal stimulation was achieved only when far red was added to continuous light. The duration of the period of maximal apex elongation rate, as well as the reduction of the time required for floral initiation, were saturated by three inductive cycles. When far red energy was provided intermittently during 3 days of continuous light, the ability to respond varied in a circadian manner. This enhancement of flowering by far red appears to be mediated by the high irradiance response of phytochrome.

29650 Structure-function relationships of proteinase inhibitors from soybean (Bowman-Birk) and lima bean. Kay, E. (Univ. of California, Los Angeles). *J. Biol. Chem.;* **254**: No. 16, 7648-7650(25 Aug 1979).

Contributions of tyrosyl residues to trypsin-and chymotrypsin-inhibitory activities in two homologous proteinase inhibitors were investigated by modifying them with N-acetylimidazole under various conditions. The acetylation of Tyr 55 is accompanied by 60% loss in antichymotryptic activity. Deacetylation with hydroxylamine restores the activity to the original level. The acetylation of Tyr 69 parallels decrease in antitryptic activity. The inhibitor acetylated at Tyr 69 is fully active toward chymotrypsin and has 30 to 40% antitryptic activity of the native. The original level of antitryptic activity is restored upon deacetylation. The acetylated only 29% (acetylated without guanidine hydrochloride) and 17% (acetylated with guanidine hydrochloride) of the original antitryptic activity. Deacetylation partially restores the lost antitryptic activity in the inhibitor acetylated without the denaturing agent. The total and irreversible loss of antitryptic activity in samples acetylated in the presence of 8 m urea or 6 m guanidine hydrochloride is attributed to the acetylation at the ϵ-amino group of Lys 26 at the trypsin-inhibitory site.

29651 Analytical peptide mapping by high performance liquid chromatography. Fullmer, C.S.; Wasserman, R.H. (New York State Coll. of Veterinary Medicine, Ithaca, NY). Contract EY-76-S-02-2792. *J. Biol. Chem.;* **254**: No. 15, 7208-7212(10 Aug 1979).

Peptide mapping of underivatized tryptic digests of bovine and chick intestinal calcium-binding proteins has been accomplished by high performance liquid chromatography (HPLC). High precision analysis of nanomolar quantities of peptides were achieved in less than 1 h (recycle time). Peak resolution and definition are superior compared to conventional techniques and recoveries of both small (4-residue) hydrophilic and large (30-residue) hydrophobic peptides are excellent. The total amino acid composition of the bovine intestinal calcium-binding protein has been accounted for on the basis of two tryptic maps of 20 μg of protein each.

29652 Preliminary crystallographic data for Bowman-Birk inhibitor from soybean seeds. Wei, C.H.; Basu, S.P.; Einstein, J.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Biol. Chem.;* **254**: No. 11, 4892-4894(10 Jun 1979).

A well characterized soybean protease inhibitor, the Bowman-Birk inhibitor, has been crystallized at room temperature in the presence of polyethylene glycol 4000 by vapor diffusion against an ammonium sulfate solution containing 2-methyl-2,4-pentanediol. An x-ray diffraction study reveals that the inhibitor crystallizes in a hexagonal unit cell of symmetry $P6_122$(or $P6_522$) and dimensions a = b = 91.36(2) A and c = 63.93(2) A. Each of the 12 asymmetric units contains 2 molecules of molecular weight 8000. The crystal, which diffracts barely to 3-A spacings, is fairly stable to x-irradiation and has a solvent content of approximately 52% by volume.

29653 Salt-dependent interconversion of inner histone oligomers. Butler, A.P.; Harrington, R.E.; Olins, D.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Nucleic Acids Res.;* **6**: No. 4, 1509-1520(Apr 1979).

The inner histone complex, extracted from chicken erythrocyte chromatin in 2 M NaCl at pH 7.4, has been characterized by sedimentation equilibrium and sedimentation velocity. High speed sedimentation equilibrium studies indicate that in 2 M NaCl the inner histones are a weakly associating system with contributions from species ranging in molecular weight from dimer to octamer. The appearance of a single boundary (3.8S at 2 M NaCl) in sedimentation velocity studies conducted over a wide range of protein concentrations and ionic conditions indicates that the various histone oligomers present are in rapid equilibrium with one another. At higher salts the equilibrium is shifted to favor higher molecular weight species; in 4 M NaCl essentially all of the histone is octameric at protein concentrations above 0.2 mg/ml. The facile interconversion of histone oligomers suggests that small alterations in histone-histone interactions may be responsible for changes in nucleosome conformations during various biological processes.

29654 Core nucleosomes by digestion of reconstructed histone-DNA complexes. Bryan, P.N.; Wright, E.B.; Olins, D.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Nucleic Acids Res.;* **6**: No. 4, 1449-1466(Apr 1979).

Reconstructed complexes of the inner histones (H2A, H2B, H3, H4) and a variety of DNAs were digested with micrococcal nuclease to yield very homogeneous populations of core nucleosomes (ν_1). Nucleosomes containing Micrococcus luteus DNA (72% G+C); chicken DNA (43% G+C), Clostridium perfringens DNA (29% G+C); or poly(dA-dT).poly(dA-dT) have been examined by circular dichroism, thermal denaturation, electron microscopy, and DNAse I digestion. Circular dichroism spectra of all particles show a typically suppressed ellipticity at 260 to 280 nm and a prominent α-helix signal at 222 nm. All particles show biphasic melting except ν_1(dA-dT), which show three prominent melting transitions at ionic strength $\leq$ 1 mM. DNAse I digestion of ν_1 (dA-dT) produces a ladder of DNA fragments differing in length by one base residue. ν_1 (dA-dT) contain 146 base pairs of DNA and exhibit an average DNA helix pitch of 10.4 to 10.5 bases per turn. There appear to be two regions of different DNA pitch within ν_1 (dA-dT). It is suggested that the two regions of DNA pitch might correspond to the two regions of the melting profiles.

29655 Cyclopeptide alkaloids. Phencyclopeptines from the polymorphic species Ceanothus integerrimus. Lagarias, J.C.; Goff, D.; Klein, F.K.; Rapoport, H. (Univ. of California, Berkeley). *J. Nat. Prod.;* **42**: No. 2, 220-227(Mar 1979).

Seven cyclopeptide alkaloids, phencyclopeptines 1-7, have been found distributed among three forms of the shrub Ceanothus integerrimus. Chemical degradation, mass spectroscopy, and ^1H nmr spectroscopy have established structures for these seven compounds, three of which have been previously reported. The use of cyclopeptide alkaloid structure and distribution for chemotaxonomic assignments is discussed.

29656 Processiveness of DNA polymerases. Das, S.K.; Fujimura, R.K. (Univ. of Tennessee, Oak Ridge). Contract W-7405-ENG-26. *J. Biol. Chem.;* **254**: No. 4, 1227-1232(25 Feb 1979).

A simple procedure for analyzing the processiveness of DNA polymerases is described. The primer-template used was poly(dA)$_{800}$:oligo(dT)$_{10}$, and the product was isolated by oligo(dT)-cellulose chromatography. The number of dTMP residues added per association was determined from the [^{3}H]dThd + [3'-^{3}H]dTMP/[^{3}H]dThd ratio of the product after its digestion by micrococcal nuclease and spleen phosphodiesterase. Using this procedure, it was found that Escherichia coli DNA polymerase I, T4 DNA polymerase, and calf thymus α- and β-DNA polymerase are quasi-processive. Most of these enzmes add on the average $\sim$ 10 to 15 nucleotides before dissociating from the template. T5 DNA polymerase, on the other hand, is processive, i.e. it continues to replicate a given template until it is very close to the 5' end of the template. With nicked DNA-like poly(dA):oligo(dT), the processiveness of E. coli DNA polymerase I is increased 2- to 2.5-fold. The significance of this increase in determining the patch size during DNA repair is discussed.

29657 Light-reaction of the green photosynthetic bacterium Chlorobium limicola f. thiosulfatophilum at cryogenic temperatures. Knaff, D.B. (Texas Tech Univ., Lubbock); Olson, J.M.; Prince, R.C. *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **98**: No. 2, 285-289(Feb 1979).

We have re-investigated the primary photochemistry of Chl. limicola f. thiosulfatophilum at cryogenic temperatures using membrane fragments (chromatophores) and a partially purified bacteriochlorophyll reaction center complex (unit membrane vesicles [5,18]). We find that the g 1.90 iron-sulfur center behaves as would be expected for a Rieske-type component rather than as a component involved in the primary photochemistry.

29658 Saturation of DNA repair in mammalian cells. Ahmed, F.E.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Photochem. Photobiol.;* **29**: 983-989(1979).

Excision repair seems to reach a plateau in normal human cells at a 254 nm dose near 20 J/m^2. We measured excision repair in normal human fibroblasts up to 80 J/m^2. The four techniques used (unscheduled DNA synthesis, photolysis of BrdUrd incorporated during repair, loss of sites sensitive to a UV endonuclease from Micrococcus luteus, and loss of pyrimidine dimers from DNA) showed little difference between the two doses. Moreover, the loss of endonuclease sites in 24h following two 20 J/m^2 doses separated by 24h was similar to the loss observed following one dose. Hence, we concluded that the observed plateau in excision repair is real and does not represent some inhibitory process at high doses but a true saturation of one of the rate limiting steps in repair.

29659 Modification of the Dittmer-Lester reagent for the detection of phospholipid derivatives on thin-layer chromatograms. Ryu, E.K.; MacCoss, M. (Argonne National Lab., IL). *J. Lipid Res.;* **20**: 561-563(1979).

A simple modification of the Dittmer-Lester reagent is described that allows the detection of phospholipid derivatives at very low concentrations on silica gel and reversed-phase thin-layer plates. This modification, which involves the addition of acetic acid to the mixture, permits the observation of sharp blue spots on a white background. The specificity and sensitivity of the spray are discussed.

29660 Carbon metabolism of chloroplasts in the dark: oxidative pentose phosphate cycle versus glycolytic pathway. Kaiser, W.M.; Bassham, J.A. (Univ. of California, Berkeley). *Planta;* **144**: 193-200(1979).

The conversion of U-labelled [^{14}C]glucose-6-phosphate into other products by a soluble fraction of lysed spinach chloroplasts has been studied. It was found that both an oxidative pentose phosphate cycle and a glycolytic reaction sequence occur in this fraction. The formation of bisphosphates and of triose phosphates was ATP-dependent and occurred mainly via a glycolytic reaction sequence including a phosphofructokinase step. The conversion of glucose-6-phosphate via the oxidative pentose phosphate cycle stopped with the formation of pentose monophosphates. This was found not to be because of a lack in transaldolase (or transketolase) activity, but because of the high concentration ratios of hexose monophosphate/pentose monophosphate used in our experiments for simulating the conditions in whole chloroplasts in the dark. Some regulatory properties of both the oxidative pentose phosphate cycle and of the glycolytic pathway were studied.

29661 Reversible inhibition of the Calvin cycle and activation of oxidative pentose phosphate cycle in isolated intact chloroplasts by hydrogen peroxide. Kaiser, W.M. (Univ. of California, Berkeley). *Planta;* **145**: 377-382(1979).

Hydrogen peroxide (6 x 10^{-4} M) causes a 90% inhibition of CO_2-fixation in isolated intact chloroplasts. The inhibition is reversed by adding catalase (2500 U/ml) or DTT (10 mM). If hydrogen peroxide is added to a suspension of intact chloroplasts in the light, the incorporation of carbon into hexose- and heptulose bisphosphates and into pentose monophosphates is significantly increased, whereas; carbon incorporation into hexose monophosphates and ribulose 1,5-bisphosphate is decreased. At the same time formation of 6-phosphogluconate is dramatically stimulated, and the level of ATP is increased. All these changes induced by hydrogen peroxide are reversed by addition of catalase or DTT. Additionally, the conversion of [^{14}C]-glucose-6-phosphate into different metabolites by lysed chloroplasts in the dark has been studied. In presence of hydrogen peroxide, formation of ribulose-1,5-bisphosphate is inhibited, whereas formation of other bisphosphates, of triose phosphates, and pentose monophosphates is stimulated. Again, DTT has the opposite effect. The release of $^{14}CO_2$ from added [^{14}C]glucose-6-phosphate by the soluble fraction of lysed chloroplasts via the reactions of oxidative pentose phosphate cycle is completely inhibited by DTT (0.5 mM) and re-activated by comparable concentrations of hydrogen peroxide. These results indicate that hydrogen peroxide interacts with reduced sulfhydryl groups which are involved in thee light activation of enzymes of the Calvin cycle at the site of fructose- and sedoheptulose bisphosphatase, of phosphoribulokinase, as well as in light-inactivation of oxidation pentose phosphate cycle at the site of glucose-6-phosphate dehydrogenase.

29662 Linear dichroism of light harvesting bacteriochlorophyll proteins from Rhodopseudomonas sphaeroides in stretched polyvinyl alcohol films. Bolt, J.; Sauer, K. (Univ. of California, Berkeley). *Biochim. Biophys. Acta;* **546**: 54-63(1979).

Light-harvesting bacteriochlorophyll-protein complexes from Rhodopseudomonas sphaeroides 2.4.1 and R-26 mutant are solubilized in sodium dodecyl sulfate and imbedded in polyvinyl alcohol. Stretching induces orientation, and the linear dichroism of visible and near infrared absorption is analyzed. Based on a simple model, angles between the particle axis and the transition dipole moments are found. In the near infrared absorption band of the R-26 light-harvesting protein the dichroic ratio varies from 1.30 to 1.57. Using the absorption curves the band is resolved into two exciton components. In the visible absorption band the dichroic ratio has a constant value of 0.43 for the R-26 protein but varies with wavelength for the wild type light-harvesting protein. This variation is attributed to an additional bacteriochlorophyll not present in the R-26 protein.

29663 New spectral components in high resolution absorption spectra of green bacterial reaction center complexes at 5K. Whitten, W.B. (Oak Ridge National Lab., TN); Pearlstein, R.M.; Olson, J.M. Contract W-7405-ENG-26. *Photochem. Photobiol.;* **29**: No. 4, 823-828(1979).

Absorption spectra of reaction center Complexes I and II from Chlorobium limicola f. thiosulfatophilum were taken from 760 and 860 nm at 5 K. Fourth and eighth derivatives of the spectra were calculated from the digital data. Light-minus-dark difference spectra were taken, also at 5 K, with 590 nm actinic light. A shoulder not visible at 77 K appears on the long wavelength side of the 834 nm peak in Complex I. In Complex II, which is derived by guanidine HCl treatment of I, the shoulder is much more pronounced; derivative peaks appear at 834 and 838 nm. In the difference spectra, there are troughs at 832 and 838 nm. The latter trough is the first instance in green bacteria of a wavelength coincidence between a light-induced bleaching and a peak in (derivative) absorbance. There is also a nearly symmetrical pair of features, a trough at 814 nm and a peak at 818 nm, that appear to represent a light-induced bathochromic shift of the absorbance at 816 nm, a peak which occurs in both complexes as well as the photochemically inert bacteriochlorophyll α (Bchl α)-protein. Other features in the absorption spectra of both Complexes occur at virtually the same wavelengths as the peaks in purified Bchl α-protein trimer. It is concluded that a large fraction of the Bchl α in Complex II is in a conformation similar to that of a single subunit of Bchl α-protein.

29664 In vivo control mechanism of the carboxylation reaction. Bassham, J.A.; Krohne, S.; Lendzian, K. (Univ. of California, Berkeley). pp 77-93 of Photosynthetic carbon assimilation. Siegelman, H.W.; Hind, G. (eds.). New York, NY; Plenum Publishing Corp. (1978).

The activity of RuBP carboxylase is strongly regulated in light and dark, becoming minimal in vivo in the dark as part of the mechanisms of avoiding wasteful reactions. Changes in pH, Mg^{2+}, NADPH and other metabolites account for this change in activity. Probably these effectors also account for some fine control of RuBP carboxylase activit in the light, permitting the rate of carboxylation to be balanced against rate of utilization of photosynthate. A major form of regulation of RuBP carboxylase in leaves is conversion of the enzyme to a high K/sub m/(CO_2) form in the presence of high ratios of total RuBP to enzyme binding sites and in the presence of very low levels of CO_2. This regulation provides a measure of protection against photorespiration resulting from the attack of O_2 on RuBP leading to phosophoglycolate formation. Steady-state concentrations of RuBP in the unicellular alga Chlorella are much higher than would appear to be tolerable to leaf cells, which suggests the possibility of different degrees of inhibition by RuBP in algae and in higher plants.

29665 Sensitized photooxidation of amino acids: effects on the reactivity of their primary amine groups with fluorescamine and o-phthalaldehyde. Straight, R. (Veterans Administration Hospital, Salt Lake City, UT); Spikes, J.D. Contract EY-76-S-02-0875. *Photochem. Photobiol.;* 27: 565-569(1978).

The photooxidation of his, met, trp, and tyr with methylene blue and eosin as sensitizers resulted in a loss of primary amine reactivity as measured with fluorescamine and o-phthalaldehyde. The rates of oxygen uptake and of loss of primary amine reactivity with illumination was characteristic for each amino acid. Glycine did not photooxidize and showed no change in primary amine reactivity. Primary amine reactivity of the N-acetyl derivatives of these amino acids was negligible and during photooxidation the reactivity increased slowly with N-acetylhis and N-acetyltrp while the reactivity of N-acetylmet and N-acetyltyr did not change. Imidazole and indole also showed a slow increase in primary amine reactivity loss during sensitized photooxidation. The rate of oxygen uptake and primary amine reactivity loss during the sensitized photooxidation of his and met was markedly increased in deuterium oxide. This indicated that singlet oxygen was involved. Radical scavengers did not affect the rates indicating that free radical intermediates were not involved. Primary amine reactivity loss is probably due to intra- and/or inter-molecular secondary dark reactions between unknown initial oxygenation products and primary amino groups.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 29749

29666 ^{13}C NMR evidence of the slow exchange of tryptophans in dihydrofolate reductase between stable conformations. London, R.E. (Univ. of California, Los Alamos, NM); Groff, J.P.; Blakley, R.L. *Biochem. Biophys. Res. Commun.;* 86: No. 3, 779-786(1979).

^{13}C NMR spectra are reported for dihydrofolate reductase of Streptococcus faecium labeled with [γ-^{13}C]tryptophan. Two of the four tryptophans generate unusual resonances indicating slow exchange of the residues between alternative stable conformations. Since 3', 5'-dichloromethotrexate sharpens two of the resonances, it apparently locks the corresponding residues into one conformation.

29667 Brain and retina uptake of a radio-iodine labeled psychotomimetic in dog and monkey. Sargent III, T.; Braun, G.; Braun, U.; Budinger, T.F.; Shulgin, A.T. (Univ. of California, Berkeley). *Commun. Psychopharmacol.;* 2: 1-10(1978).

4-Iodo-2,5-dimethoxyphenylisopropylamine (4-I-DPIA) is a close analog of methoxylated psychotomimetic compounds related to 6-hydroxydopamine. Such compounds are of interest as possible endogenous psychotoxins in schizophrenia, and when labeled with a suitable gamma-emitting radioisotope their in vivo pharmacokinetics may be studied in animals or humans. 4-I-DPIA was prepared with ^{131}I and with ^{123}I and its distribution studied in dog and monkey using imaging devices of nuclear medicine. Images were obtained showing isotope accumulation in the brain and eyes in both animals; the measured uptake half-time in the monkey brain was 8 sec. Sacrifice and dissection of the dogs showed 2% of the activity in the brain, 18% in liver and 12% in lung. The concentration in retina was 5 times that in any other CNS tissue, supporting the concept that direct action at the retinal level is a component of visual misperception caused by phychotomimetics.

CYTOLOGY

REFER ALSO TO CITATION(S) 29639, 29646, 29653, 29654, 29659, 29681, 29698, 29701, 29702, 29703, 29714

29668 (BNL—27917) Ultrastructure of unstained, hydrated proteoglycan aggregates and monomer: a new method of imaging. Panessa, B.J.; Hoffman, P.; Warren, J.B.; McCorkle, R.A.; Coleman, G. (State Univ. of New York, Stony Brook (USA). Dept. of Orthopedics; Brookhaven National Lab., Upton, NY (USA); Thomas J. Watson Research Center, Yorktown Heights, NY (USA)). 1980. Contract AC02-76CH00016. 4p. (CONF-800821—1). NTIS, PC A02/MF A01.

From 7. European electron microscopy congress and the international x-ray optics and microanalysis conference; Hague, Netherlands (24 Aug 1980).

The application of a new method for imaging delicate hydrated biological materials is reported, and the structure of isolated proteoglycan aggregates and monomer is demonstrated at better than 30 nm resolution. This new method for high resolution examination of labile hydrated biological materials, employing a wet cell and pulsed plasma x-ray source, permits short exposure times, minimal specimen damage, and sufficient radiation dosages for imaging. (ERB)

29669 (CONF-800653—1) Fundamental aspects of the freezing of cells, with emphasis on mammalian ova and embryos. Mazur, P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

From 9. international congress on animal reproduction and artificial insemination; Madrid, Spain (16 Jun 1980).

The problem in cryobiology is how to cool cells to -196°C and return them to normal temperatures without killing them. One important factor is the presence of a protective additive like glycerol or dimethyl sulfoxide. Mammalian cells rarely survive freezing to below -40°C in its absence. In the presence of an additive, survival is critically dependent on the cooling rate. Supraoptimal rates and suboptimal rates are both damaging. Death at supraoptimal rates is the result of the formation of intracellular ice and its recrystallization during warming. Death at suboptimal rates is a consequence of the major alterations in aqueous solutions produced by ice formation. The chief effects are a major reduction in the fraction of the solution remaining unfrozen at a given temperature and a major increase in the solute concentration of that fraction. The introduction of molar concentrations of additive greatly reduces both the fraction frozen and the concentration of electrolytes in the unfrozen channels and in the cell interior. Usually, freezing either kills cells outright or it results in survivors that retain full capacity to function. But there is the possibility that in some cases survivors may in fact be impaired genetically or physiologically. All evidence indicates that genetic damage does not occur. But there are clear examples in which freezing does induce nonlethal physiological damage. (ERB)

29670 Stereo electron microscopy of the 25-nm chromatin fibers in isolated nuclei. Olins, A.L.; Olins, D.E. (Oak Ridge National Lab., TN). *J. Cell Biol.;* 81: 260-265(1979).

Thin sections (0.1-0.25 μm) of isolated chicken erythrocyte nuclei were examined at various tilt angles. Stereo pairs of electron micrographs document the parallel alignment of 25-nm chromatin fibers adjacent to the nuclear envelope, and demonstrate a fiber substructure consistent with close-packed arrays of nucleosomes.

29671 Does autoregulation of Megakaryocytopoiesis occur. Ebbe, S.; Phalen, E. (Univ. of California, Berkeley). *Blood Cells;* 5: 123-138(1979).

Although a major regulator of thrombocytopoiesis is the number of circulating platelets, several observations suggest that independent alternative regulatory mechanisms may exist. In some situations there is a curious association of megakaryocytopenia and megakarocytic macrocytosis in spite of normal platelet counts. If macrocytosis is considered as a sign of stimulation, this association suggests a cause and effect relationship between decreased numbers and increased size of megakaryocytes. This thesis was tested by examining the delayed effects of sublethal irradiation and the acute effects of hydroxyurea in mice. It was found that megakaryocytopenia and macromegakaryocytosis occurred together and that platelet counts were either normal or only slightly reduced. Therefore it was concluded that normal numbers of platelets could be produced by decreased numbers of megakaryocytes. Megakaryocytopenia appeared to be compensated, in part, by increased size of megakaryocytes, but the mechanism by which this occurred has not been elucidated. It is postulated that a reduction in the number of cells of the megakaryocytic system is sensed by a homestatic mechanism that then acts to stimulate the cells that are present. This stimulation may then be manifested as macrocytosis of megakaryocytes.

29672 Measurement of unscheduled synthesis by autoradiography. Cleaver, J.E.; Thomas, G.H. (Univ. of California, San Francisco). pp vp, 24 of Handbook of DNA repair techniques. Friedberg, E.C.; Hanawalt, P.C. (eds.). New York, NY; Marcel Dekker, Inc. (1979).

Autoradiography was one of the original methods by which repair was discovered, and remains a dramatic visual method by which repairing cells can be observed. It can be applied to most cellular systems and can be particularly valuable in mixed cell populations in which cells cannot be physically separated but can be visually discriminated. Very low levels of excision repair can be detected by the use of high specific activity ^{3}HdThd (40 to 60 Ci/mmole, 1 ^{3}H atom per dThd molecule corresponds to 30 Ci/mmole) image enhancement and long autoradiographic exposure times, although some combinations run the risk of high background, and latent image fading (and loss of investigators' interest).

29673 Temperature sensitivity of daily respiratory patterns entrained through phytochrome action on Lemna paucicostata strain 6746. Hillman, W.S. (Brookhaven National Lab., Upton, NY). *Physiol. Plant.;* 47: 56-60(1979).

The respiration rate of heterotrophic Lemna paucicostata Hegelm. 6746 cultures at 26 to 27°C and given a brief pulse of red light, assumes patterns with properties dependent on the nitrogen source supplied. In a search for conditions specifically affecting features of those patterns expressing photoperiodic timing, their amplitudes have been measured as relative peak height (RPH) - the increased height at the daily peak as a proportion of the average

daily minimum - at both 21°C and 28°C. On nitrate, ammonium or aspartate medium, RPH is reduced roughly 70% at 21°C as compared to 28°C, but on nitrogen-deficient medium the reduction is only 20 to 30%. Yet growth and the actual intensity of respiration are not differently temperature sensitive on NO_3 and N-deficient media. Nor does RPH itself correlate with growth rate. Previous evidence indicates that patterns on NO_3 and NH_4 media reflect photoperiodic timing and that those on aspartate and N-deficient media do not; hence the temperature sensitivity of RPH does not correlate with whether or not a pattern reflects photoperiodic timing. However, different daily patterns are elicited by pulses of red or far-red on NO_3, NH_4 and aspartate media but not on the N-deficient. Hence the temperature sensitivity of RPH does correlate with the degree to which the patterns distinguish between red and far-red, which is to say between high and low levels of Pfrphytochrome. This suggests that high temperature sensitivity in RPH reflects a reaction limited by N assimilation and saturating only at relatively high levels of Pfr.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 29733

29674 Proliferation kinetics of early hemopoietic precursor cells with self sustaining capacity in the mouse, studied with 125-I-labeled iodo-deoxyuridine. Siegers, M.P.; Feinendegen, L.E. (Institute of Medicine, Nuclear Research Center Juelich GmbH, and University of Duesseldorf, Department of Nuclear Medicine, Juelich, W. Germany); Lahiri, S. (77 Mahatma Gandhi Road, Calcutta-41, India); Crinkite, E.P. (Brookhaven National Lab., Upton, NY (USA)). *Exp. Hematol.;* 7: No. 9, 469-482(1979).

With a new labelling technique in radiation chimeras, an attempt was made to determine the duration of the phases of the stem cell cycle including shortest and mean generation time and to estimate the number of hemopoietic stem cells per unit of bone marrow cellularity. The DNA of bone marrow cells in DNA synthesis was labeled with 5-^{125}I-2'- deoxyuridine. The labeled cells were followed after being transfused into fatally irradiated mice. The stem cells were found to have a half-time of about 4.3 days in the donor mice. The average time in the population, i.e. the turnover time of the stem cells, was 6.2 days. The half-time did not change significantly even after transfusion of bone marrow into lethally irradiated recipient mice. Tritiated thymidine (^{3}H-TdR) suicide technique revealed that bone marrow stem cells seeding to the spleens and to the femurs of lethally irradiated recipients behaved differently - S-phase in cells seeding to femurs being shorter. The radiosensitivity of stem cells in S-phase had a D_0 of 80 rad whereas stem cells distributed throughout the whole cell cycle had a D_0 of 185 rad. The respective extrapolation numbers were 1.23 and 1.14. It is calculated that 2-7% of all nucleated bone marrow cells belong to self renewing stem cell populations. The method described provides a new approach for the study of hematological stem cells.

29675 Erythroid colony production in vitro as a function of exposure time to erythropoietin. Kennedy, W.L.; Alpen, E.L.; Garcia, J.F. (Univ. of California, Berkeley). *Blood Cells;* 4: 143-154(1978).

The effects of timed exposure to erythropoietin of murine bone marrow cells has been studied in in vitro plasma clot cultures. Erythropoietin was added at the start of the incubation period, and at various times after initiation of the culture an anti-erythropoietin serum was added in an amount adequate to neutralize the erythropoietin. Culture methods were used which allow the transformation of the immediate progenitor stem cell of the recognized erythron, the CFU-E. The incorporation of ^{59}Fe was used as an identity marker for hemoglobin synthesis which allowed the classification of colonies as erythroid in autoradiographs. Brief exposure to the hormone for one to two hours produced activation of about 20% of the control (continuous exposure for the 48 h of culture) value. More protracted exposure to erythropoietin caused the conversion of what appears to be a second population of CFU-E, but even 24 h of exposure was not adequate to cause the maximum activation of CFU-E seen in the control cultures.

GENETICS

REFER ALSO TO CITATION(S) 29641, 29642, 29695, 29698, 29700, 29718, 29736

29676 (COO—1300-44) Cycle pattern of a R allelic variation. Progress report, 1 November 1978-31 January 1980. Kermicle, J.L. (Wisconsin Univ., Madison (USA)). 1980. Contract AS02-76EV01300. 9p. NTIS, PC A02/MF A01.

Two R alleles vary in cycle fashion. The original, intensely pigmenting forms change to weakly acting ones which revert in turn to the original. Neither direction of change is correlated with recombination of flanking markers. The reversion frequencies do not differ from the respective frequencies of change in the forward direction. The changes are restricted in the life cycle to about the time of meiosis. Modifying tthe incidence of crossing over in the R region altered the frequency of reversion proportionately. These features of instability could result from switching by intrachromosomal recombination between alternative arrangements of an R segment associated with an inverted duplication.

29677 (COO—4366-2) Molecular mechanisms of mutagenesis and carcinogenesis. Final report, November 1, 1978-October 31, 1979. Ptashne, M. (Harvard Univ., Cambridge, MA (USA)). Apr 1980. Contract AS02-77EV04366. 9p. NTIS, PC A02/MF A01.

The recA gene product mediates induction of a battery of cellular functions in E. coli collectively known as the SOS inducible functions. These include prophage induction, induction of filamentous cell growth, induction of DNA repair systems and induction of the recA gene itself. Prophage induction has been demonstrated to result from cleavage of the phage repressor protein by a specific protease function of the recA protein. Such cleavage destroys repressor function in lysogenic cells and allows the prophage to enter the vegetative growth cycle. Normally, the protease function of recA protein only becomes active in the cell in response to signals produced by agents (carcinogens) or treatments that specifically damage DNA or interfere with DNA replication. In the tif-1 mutant of recA, however, the protease can be made to be active simply by raising the temperature of the culture from 30° to 40° C; λ prophage is induced and the cell produces a normal burst of phage. Indeed, all known SOS functions are also induced under these conditions. Thus, it has been proposed that all SOS functions are similarly regulated by repressors that are sensitive to the recA portease function. We have sought to further characterize the recA-/mediated cleavage reaction and its requirements for λ repressor in vitro and to extend our biochemical studies to a cellular SOS repressor, the lexA gene product which is proposed to negatively regulate several SOS inducible functions, including the recA gene, a gene controlling cell separation and lexA gene itself.

29678 (LA—8359-T) Histone modifications and their relationship to constitutive heterochromatin content in cultured peromyscus cells. Halleck, M.S. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-48. 165p. NTIS, PC A08/MF A01. Thesis.

Biochemical research in recent years has provided evidence that control of genetic activity in eucaryotic cells may be accomplished by the modulation of chromatin structure caused by reversible modifications of chromatin proteins, in particular, the histones. In order to test the hypothesis that biochemical modifications of histone proteins are involved in condensation of chromatin (heterochromatization) histones were analyzed from three cultured cell lines from mice of the genus Peromyscus. Radiolabeled histones extracted from these cell lines were analyzed using preparative polyacrylamide gel electrophoresis with non-ionic detergent present to facilitate separation of hydrophobic histone variants. It was found that P. eremicus cells, which contain 34% more heterochromatin that P. boylii cells, also contain a larger proportion of the more hydrophobic H2A variant (MHP-H2A). This MHP-H2A variant was also two times more phosphorylated than the other, less hydrophobic H2A variant (LHP-H2A) in these cell lines. When unlabeled histones were extracted and subjected to analytical polyacrylamide gel electrophoresis, it was found that these high heterochromatin P. eremicus cells also contained 28 to 35% more unacetylated H4, 22 to 29% more unacetylated H3, and 18 to 22% more unacetylated H2B than low heterochromatin cells (P. bovlii, P. crinitus). Thus, histone acetylation was found to be inversely proportional to constitutive heterochromatin content in these cell lines. Certain histone modifications were thus found to be related to constitutive heterochromatization in these cell lines.

29679 (UCRL—84063) Regional gene mapping of human chromosomes purified by flow sorting. Carrano, A.V.; Lebo, R.V.; Yu, L.C.; Kan, Y.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1980. Contract W-7405-ENG-48. 33p. (CONF-800659—1). NTIS, PC A03/MF A01.

From Workshop on modern trends in human leukemia IV; Wilsede, F.R. Germany (14 Jun 1980).

Analysis and sorting of chromosomes using fluorescence-based high speed flow systems was reported in 1975. In the ensuing five years these principles have been applied to karyotype analysis and to chromosome biochemistry and cytochemistry. The results of these investigations indicate that the use of these systems for chromosome analysis and sorting is an important adjunct to existing cytogenetic techniques and a primary resource for molecular cytogenetics studies of individual chromosomes. This brief report describes one application of this approach, namely, regional gene mapping of human chromosomes.

29680 Bacteriophage T5 transfer RNA. Hunt, C.; Desai, S.M.; Vaughan, J.; Weiss, S.B. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *J. Biol. Chem.;* **255**: No. 7, 3164-3173(10 Apr 1980).

Previous studies from this laboratory have provided a high resolution map for 16 tRNA genes located on the continuous heavy DNA strand of bacteriophage T5 DNA. All of the T5 tRNA genes were located in three clusters within the DNA C segment, except for tRNA/sup Arg/, which mapped on the left end of the DNA D segment. In this report, we present evidence for the presence of eight additional T5 tRNA species, five of which are located in two new loci within the DNA C segment. We also describe a two-dimensional gel electrophoresis system for the separation and isolation of T5 tRNA species from crude infected RNA preparations. The gel electrophoresis system separates tRNA isoacceptors specific for different amino acids; evidence is presented that the isoacceptors for isoleucine, histidine, and serine are coded by different T5 genes.

29681 DNA fork displacement rates in synchronous aneuploid and diploid mammalian cells. Kapp, L.N.; Painter, R.B. (Univ. of California, San Francisco). *Biochim. Biophys. Acta;* **562**: 222-230(1979).

DNA fork displacement rates were measured in Chinese hamster ovary cells (CHO), human HeLa cells and human diploid fibroblasts. For CHO cells two independent techniques were used: one based on CsCl equilibrium density gradients and the other on 313 nm photolysis of incorporated bromodeoxyuridine (BrdUrd). Both methods indicated that there was no significant variation in fork displacement rates in CHO cells as they progressed through S phase. Asynchronous CHO cultures displayed the same average value (1.0 μm/min) and range of values as found in synchronous cells. In contrast, the rate of DNA fork displacement in HeLa cells, measured by the BrdUrd-313 nm method, increased continuously from 0.8 μm/min in early S to 2.5 μm/min in late S. For human diploid fibroblasts, in early S, the rate was approximately 0.7 μm/min and decreased to a minimum of 0.5 μm/min in mid S. The replication fork displacment rate then increased to a maximum of 0.9 μm/min in late S and declined again before the end of S phase. This pattern of DNA fork displacement rates roughly paralleled the overall thymidine incorporation rate and appears quite different from the patterns found for HeLa and CHO cells.

29682 Yeast UAA suppressors effective in psi + strains: leucine-inserting suppressors. Ono, B.I.; Stewart, J.W.; Sherman, F. (Univ. of Rochester, NY). *J. Mol. Biol.;* **132**: 507-520(1979).

We have previously reported the isolation and characterization of UAA suppressors from a haploid strain of yeast Saccharomyces cerevisiae containing the psi^+ non-Mendelian determinant which increases the efficiency of action of certain suppressors (Ono et.al, 1979). Most of the suppressors caused the insertion of either tyrosine or serine. In contrast, the pattern of suppression of nutritional markers suggested that the rare suppressor, SUP26, inserted in an amino acid other than tyrosine or serine. In this investigation we report the characterization of additional suppressors, similar to SUP26, that were isolated on a medium lacking uracil and containing canavanine; this medium is expected to exclude serine-inserting suppressors because they do not suppress the ura4-1 marker, and to exclude tyrosine-inserting suppressors because they suppress the can1-100 marker. The total of 155 revertants similar to the SUP26 suppressor were analyzed genetically and these could be assigned to one or another of the six distinct loci SUP26, SUP27, SUP28, SUP29, SUP32 and SUP33. The SUP26, SUP27 and SUP29 loci mapped on chromosomes XII, IV and X, respectively. The detailed map position of the SUP29 suppressor suggests that it may be allelic to the SUP30 suppressor reported by Hawthorne and Mortimer (1968). These six suppressors had the same pattern of suppression of UAA nutritional markers and all of them had a similar low efficiency of action on the iso-1-cytochrome c mutation cyc1-72. The efficiency of each of these suppressors was increased by a chromosomal allosuppressor, sal. Each of the six suppressors caused the insertion of leucine in iso-I-cytochrome c at the UAA site of the cyc1-72 mutation. It is suggested that the gene products of these suppressors are redundant forms of the same leucine transfer RNA.

29683 Restricted fragmentation of poliovirus type 1, 2, and 3 RNAs by ribonuclease III. Nomoto, A. (State Univ. of New York, Stony Brook); Lee, Y.F.; Babich, A.; Jacobson, A.; Dunn, J.J.; Wimmer, E. *J. Mol. Biol.;* **128**: 165-177(1979).

Cleavage of the genome RNAs of poliovirus type 1, 2, and 3 with the ribonuclease III of Escherichia coli has been investigated with the following results: (1) at or above physiological salt concentration, the RNAs are completely resistant to the action of the enzyme, an observation suggesting that the RNAs lack primary cleavage sites; (2) lowering the salt concentration to 0.1 M or below allows RNase III to cleave the RNAs at secondary sites. Both large and small fragments can be obtained in a reproducible manner depending on salt conditions chosen for cleavage. Fingerprints of three large fragments of poliovirus type 2 RNA show that they originate from unique segments and represent most if not all sequences of the genome. Based upon binding to poly(U) filters of poly(A)-linked fragments, a physical map of the large fragments of poliovirus type 2 RNA was constructed. The data suggest that RNase III cleavage of single-stranded RNA provides a useful method to fragment the RNA for further studies.

TRACER TECHNIQUES

29684 (DOE/EV/04182—10) Differential gene expression in neurospora crassa cell types: amplification of rRNA genes. Progress report, July 1979-30 June 1980. Dutta, S.K. (Howard Univ., Washington, DC (USA)). 1980. Contract AS05-76EV04182. 17p. NTIS, PC A02/MF A01.

The significant results obtained during 1979 to 1980 of the current research program are as follows: (1) the differential rRNA gene amplification in germinated conidia of N.crassa was confirmed. N.crassa rDNAs showed differences in degrees of homology with isolated DNAs from other Neurospora species which could be due to heterogeneity in internal spacers. Studies with N.crassa rDNA clones were initiated to study their heterogeneities. The organization of the Institutional Biohazard Committee (IBC) for Recombinant DNA research was completed and necessary certifications for the laboratory and the workers were obtained in accordance with the P_3EK_1 containment regulation of N.I.H. Known 17S and 26S N.crassa rDNA probes are being used to detect differences, if any, in restriction cleavage sites in rDNAs of different cell types and developmental mutants of N.crassa. DNAs from these N.crassa cells are restricted with $EcoR_1$ and Hind III and cleaved fragments separated by gel electrophoresis are transferred into nitrocellulose papers. Experiments are underway now to see if there are any changes in cleavage sites by annealing with ^{32}P or ^3H-17S or 26S rDNA probes followed by autoradiography.

METABOLISM

REFER ALSO TO CITATION(S) 29660, 29661, 29752

29685 Distribution, fluxes and biological utilization of inorganic nitrogen during a spring bloom in the New York Bight. Conway, H.L.; Whitledge, T.E. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Mar. Res.;* **37**: No. 4, 657-668(1979).

The utilization of ammonium (NH_4) and nitrate (NO_3) by natural phytoplankton communities was measured during a Ceratium tripos-dominated spring bloom in the New York Bight. During 6 to 8 hour uptake experiments, the inshore phytoplankton communities that were typically located at depths ≧ 25 m were characterized by NH_4 and NO_3 uptake rates that were less light-dependent than those of the more uniformly distributed communities at the shelf break. Measurements of NH_4 utilization, as a percentage of NH_4 plus NO_3 utilization, yielded values of 59% inshore and 70% at the shelf break. High biomass of zooplankton at the shelf break suggested they could account for ~ 62% of the regenerate production (i.e, based on NH_4), while inshore, estimates of regenerated NH_4 from zooplankton, benthos and bacterioplankton could account for 38 to 53% of the phytoplankton requirements. In the cross-shelf distribution, the ambient concentrations of NH_4 and NO_3 in the surface water were ~ 0.4 and ~ 0.1 μmol L^{-1}, respectively; however at depths between 25 and 50 m, concentrations of ~ 2and ~ 4 μmol L^{-1} were observed.

29686 Effects of estrogens and progestins on high density lipoproteins. Krauss, R.M.; Lindgren, F.T.; Wingerd, J.; Bradley, D.D.; Ramcharan, S. (Univ. of California, Berkeley). *Lipids;* **14**: No. 1, 113-118(1979).

High density lipoprotein (HDL) levels are knwon to be higher in women than in men, and to increase with estrogen use. To assess the effects of estrogens on HDL subspecies, analytic ultracentrifuge measurements of HDL were compared in 11 menopausal estrogen users and 16 controls. The difference in mean schlieren patterns between the groups showed a significantly higher level of HDL with flotation rate ($F_{1\ 20}°$) > 1.5 (predominantly HDL_2) in the users. This was similar to the difference in HDL seen between nonusers of hormones and age-matched males. A previous study had shown that users of combination oral contraceptives had increased levels of HDL with $F_{1\ 20}° \leqq 3.5$ (primarily HDL_2) suggesting that the estrogen effect on HDL is altered by the presence of added progestin. The progestin effect was studied here in detail in two women with type V hyperlipoproteinemia treated with norethindrone acetate. Reduction in serum triglyceride was accompanied by a reduction in HDL, predominantly in the less dense species (HDL_2). Among groups of oral contraceptive and noncontraceptive estrogen and progestin users whose HDL-cholesterol levels have been reported recently, there was a direct correlation ($r = 0.86$, $p < .001$) between mean HDL-cholesterol and triglyceride levels. Endogenous hormonal influences on HDL were assessed by serum hormone and lipoprotein measurements at weekly intervals during two consecutive menstrual cycles in four healthy females. An in-

crease in HDL of highest flotation rate ($F_{1\ 20}$° 5 to 9) was seen, which corresponded with the time of ovulation, raising the possibility of pituitary as well as gonadal hormone effects on HDL.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 29753

MEDICINE

REFER ALSO TO CITATION(S) 29560, 29686, 29730

29687 Blood-surface interactions as a basis for selection of blood-compatible cardiovascular implantable materials. Srinivasan, S.; Ramasamy, N.; Stanczewski, B.; Sawyer, P.N. (State Univ. of New York, Brooklyn). *Adv. Cardiovasc. Phys.;* **3**: 133-163(1979).

Thrombosis on the blood vessel wall or on prosthetic materials is one of the most serious cardiovascular problems. Thrombosis occurs at a solid-electrolyte interface and is markedly influenced by the electrochemical characteristics across the interface. In the present chapter is presented a summary of the results on the correlation between the electrochemical and antithrombogenic characteristics of materials. Conducting materials, registering potentials below + 100 mV versus Normal Hydrogen Electrode (NHE) in blood, tend to be nonthrombogenic. The corrodible metals belong to this class. Noble metals are thrombogenic. However, by maintaining them at negative potentials in blood, versus NHE, they can be made nonthrombogenic. Metals and alloys, presently used in production of cardiac valves, remain passive in blood and physiologic saline. In practical cardiac prostheses, the surface contamination appears to play a major role in thrombogenesis. Polymeric materials exhibiting negative zeta potentials generally tend to be nonthrombogenic. Chemical treatment of insulator materials to introduce negatively charged groups, such as sulfonate and carboxylate, improves the blood compatibility. Cross-linking of heparin on surfaces and biolization of materials are new approaches to preparing stable nonthrombogenic materials. Blood-surface interactions, investigated at a molecular level, are also briefly outlined. Blood coagulation factors take part in adsorption and charge transfer reactions across metal-solution interfaces.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 29726

29688 Transverse section imaging with carbon-11 labeled carbon monoxide. Brownell, G.L.; Cochavi, S. *J. Comput. Assist. Tomogr.;* **2**: No. 5, 533-538(1978).

The inhalation of small quantities of carbon-11 labeled carbon monoxide results in a useful red cell label to identify vascular structures in the body and quantitate red cell concentration in tissues. Transverse section images are obtained using PC-11, the Massachusetts General Hosptial (MGH) Positron Camera. Attenuation correction is performed either by means of transmission data or by analytical methods. Sets of transverse section images give information on red cell distribution in head and torso. Such images may be useful in identifying vascular abnormalities or in quantitating red cell physiology.

29689 (UCLA—12-1239) Noninvasive measurement of regional myocardial glucose metabolism by positron emission computed tomography. Schelbert, H.R.; Phelps, M.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology; California Univ., Los Angeles (USA). Dept. of Radiological Sciences). [nd]. Contract EY-76-C-03-0012. 14p. NTIS, PC A02/MF A01.

While the results of regional myocardial glucose metabolism measurements using positron emission computed tomography (^{13}N-ammonia) are promising, their utility and value remains to be determined in man. If this technique can be applied to patients with acute myocardial ischemia or infarction it may permit delineation of regional myocardial segments with altered, yet still active metabolism. Further, it may become possible to evaluate the effects of interventions designed to salvage reversibly injured myocardium by this technique.

EXTERNAL RADIATION IN DIAGNOSTICS

29690 Maximum entropy reconstruction from cone-beam projection data. Minerbo, G. (Univ. of California, Los Alamos, NM). *Comput. Biol. Med.;* **9**: 29-37(1979).

An iterative algorithm for direct three-dimensional reconstruction from cone-beam projection data is presented. It is based on the maximum entropy criterion and uses an efficient parametrization of the cone-beam projection geometry. The computer memory requirements are low, and the algorithm converges rapidly in test problems. A numerical example is given of a reconstruction of a simple test object from five cone-beam views.

29691 Emission computer assisted tomography with single-photon and positron annihilation photon emitters. Budinger, T.F.; Derenzo, S.E.; Gullberg, G.T.; Greenberg, W.L.; Huesman, R.H. *J. Comput. Assist. Tomogr.;* **1**: No. 1, 131-145(1977).

Computed transverse section emission tomography using /sup 99m/Tc with the Anger camera is compared to positron annihilation coincident detection using a ring of crystals and ^{68}Ga. The single-photon system has a line spread function (LSF) of 9 mm full width at half maximum (FWHM) at the collimator and gives a transverse section reconstruction LSF of 11 mm FWHM with 144 views. The positron ring has a LSF of 6 mm at the center with a transverse section reconstruction LSF of 7.5 mm FWHM. Positron-computed section imaging has a tenfold increase in sensitivity over multiple-view imaging with the scintillation camera, which gives multiple sections but requires camera or patient rotation.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 28564, 28621, 29639, 29640, 29641, 29645, 29656, 29657, 29662, 29663, 29666, 29680, 29683, 29705, 29716, 29736, 29737

29692 Growth of Legionella pneumophila in association with blue-green algae (Cyanobacteria). Tison, D.L. (Rensselaer Polytechnic Inst., Troy, NY); Pope, D.H.; Cherry, W.B.; Fliermans, C.B. Contract AT(07-2)-1. *Appl. Environ. Microbiol.;* **39**: No. 2, 456-459(Feb 1980).

Legionella pneumophila (Legionnaires disease bacterium) of serogroup 1 was isolated from an algal-bacterial mat community growing at 45°C in a man-made thermal effluent. This isolate was grown in mineral salts medium at 45°C in association with the blue-green alga (cyanobacterium) Fischerella sp. over a pH range of 6.9 to 7.6. L. pneumophila was apparently using algal extracellular products as its carbon and energy sources. These observations indicate that the temperature, pH, and nutritional requirements of L. pneumophila are not as stringent as those previously observed when cultured on complex media. This association between L. pneumophila and certain blue-green algae suggests an explanation for the apparent widespread distribution of the bacterium in nature.

29693 Two distinct pools of membrane phosphatidylglycerol in Bacillus megaterium. Lombardi, F.J.; Fulco, A.J. (Univ. of California Medical School, Los Angeles). Contract DE-AM03-76-SF00012. *J. Bacteriol.;* **141**: No. 2, 618-625(Feb 1980).

The predominant membrane lipid in Bacillus megaterium ATCC 14581, phosphatidylglycerol (PG), is present in two distinct pools, as shown by [^{32}P]phosphate incorporation and chase experiments. One pool (PG/sub t/) undergoes rapid turnover of the phosphate moiety, whereas the second pool (PG/sub s/) exhibits metabolic stability in this group. The phosphate moiety of the other major phospholipid, phosphatidylethanolamine, is stable to turnover. [^{32}P]phosphate- and [2-^{3}H]glycerol-equilibrated cultures yielded the following glycerolipid composition: 56 mol% PG (34 mol% PG/sub t/ and 22 mol% PG/sub s/), 21 mol% phosphatidylethanolamine, 1 to 2 mol% phosphatidylserine, 20 mol% diglycerides, less than 0.5 mol% cardiolipin, and 0.2 to 0.4 mol% lysophosphatidylglycerol. Accumulation of PG was halted immediately after the addition of cerulenin, an inhibitor of de novo fatty acid synthesis, whereas phosphatidylethanolamine accumulation continued at the expense of the diglyceride and PG pools. Strikingly, initial rates of [^{32}P]phosphate incorporation into PG were unaffected by cerulenin. In control cultures at 35°C, incorporation of [^{32}P]phosphate into PG exhibited a biphasic time course, whereas incorporation into phosphatidylethanolamine was concave upward and lagged behind that of PG during the initial rapid phase of PG incorporation. Finally, levels of lysophosphatidylglycerolexpanded rapidly after cerulenin addition at 20°C, but not at 35°C. Moreover, incorporation of [^{32}P]phosphate into lysophosphatidylglycerol lagged behind incorporation into PG in both the presence and absence of cerulenin at 20 and 35°C.

29694 Immunofluorescent assay for the marine ammonium-oxidizing bacterium Nitrosococcus oceanus. Ward, B.B.; Perry, M.J. (Univ. of Washington, Seattle). Contract E-76-S-06-2225-TA26 #5(RLO-2225-T26-77). *Appl. Environ. Microbiol.;* **39**: No. 4, 913-918(Apr 1980).

Nitrification is one of the important microbiological transformations of nitrogen in the ocean. Traditional enrichment-culture methods for enumerating the autotrophic bacteria which oxidize ammonium to nitrite are very time consuming (months) and are believed to seriously underestimate natural abundances. A fluorescent-antibody assay for a marine ammonium-oxidizing bacterium was developed to provide a rapid and direct means of identifying these microorganisms. Antibodies to Nitrosococcus oceanus were pre-

pared and tested against pure cultures of marine, freshwater, and soil ammonium oxidizers and against bacteria from natural seawater samples. Cell counts of culture samples determined by the fluorescent-antibody assay agreed with hemacytometer and acridine orange counts. Our results demonstrated that the immunofluorescent assay is a powerful tool for the detection of Nitrosococcus in the marine environment.

29695 Characteristics of Anabaena variabilis influencing plaque formation by cyanophage N-1. Currier, T.C.; Wolk, C.P. (Michigan State Univ., Lansing). *J. Bacteriol.;* 139: No. 1, 88-92(Jul 1979).

Phage N-1 grown in Anabaena strain 7120 [N-1 . 7120] forms plaques on A. variabilis about 10^{-7} to 10^{-6} as efficiently as on Anabaena 7120. By manipulating different characteristics of the interaction between phage and host, it was possible to increase the relative efficiency of plaque formation to 0.38. Growth of A. variabilis at 40°C for at least three generations resulted in an increase in the rate of phage adsorption and a 10-fold increase in the efficiency of plaque formation. The efficiency of plaque formation was further increased about 42-fold, with little or no further increase in rate of adsorption, in a variant strain, A. variabilis strain FD, isolated from a culture of A. variabilis which had grown for more than 30 generations at 40°C. The low relative efficiency of plaque formation by N-1 . 7120 on A. variabilis could be partially accounted for if A. variabilis contains a deoxyribonucleic acid restriction endonuclease which is absent from Anabaena 7120. Indirect evidence for such an endonuclease included the following: (i) phage N-1 grown in A. variabilis (N-1 . Av) had approximately a 7×10^3-fold higher relative efficiency of plaque formation on A. variabilis than had N-1 . 7120; and (ii) the efficiency of plaque formation by N-1 . 7120 on A. variabilis strain FD was increased by up to 146-fold after heating the latter organism at 51°C.

29696 Aerosol dissemination veterinary pathogenic and human opportunistic thermophilic and thermotolerant fungi from thermal effluents of nuclear production reactors. Tansey, M.R.; Fliermans, C.B.; Kern, C.D. (Indiana Univ., Bloomington). *Mycopathologia;* 69: No. 1-2, 91-115(1979).

The extent to which veterinary pathogenic and human opportunistic species of thermophilic and thermotolerant fungi disseminate in aerosols from heated effluents of nuclear production reactors of the Savannah River Plant (SRP), South Carolina, has been measured. Aerosol samples were taken at 140 sites, from directly over thermal effluents to more than 100 kilometers from the SRP boundary. Sampling methods included settle plates, liquid impingement, filtration, and a particle sizing cascade impactor (Andersen Sampler). Soils, foams, and microbial mats from thermal effluents, and vegetation were sampled to study distribution of particular species. Sampling was done under a variety of conditions; hot weather and cold, wet and dry, day and night, windy and calm, reactor(s) operating and not, disturbed vegetation and undisturbed. At 102 of the aerosol sampling sites, sophisticated meterological analysis were used to allow sampling of air in the plume which originated from thermal effluents. Soil, foam, microbial mat, vegetation, and aerosol samples were quantitatively plated for detection of viable units; filters were halved and then both plated and observed microscopically. Significant dissemination of thermophilic and thermotolerant fungi from thermal effluents was not detected. Thermophilic and thermotolerant fungi were widely distributed in soil, air, and on vegetation. Dactylaria gallopava, the indicator species and dominant fungus in microbial mats lining SRP thermal effluents and the cause of epidemic fatal phaeohyphomycosis in flocks of turkeys and chickens in South Carolina, Georgia, and elsewhere, was isolated from air at a maximum of 50 meters from effluents.

PATHOLOGY

REFER ALSO TO CITATION(S) 29637, 29638, 29639, 29700, 29719, 29746, 29750

29697 Increasing stimulation of megakaryocytopoiesis with decreasing platelet count. Odell, T.T.; Shelton, C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proc. Soc. Exp. Biol. Med.;* 161: No. 4, 531-533(Sep 1979).

Rats were exchange transfused with platelet-poor blood to produce varying degrees of thrombocytopenia. Marrow samples were taken 31 hr later and the megakaryocyte population was scored for the percentage in endomitosis. The M/sub E/I progressively increased as the circulating platelet count was reduced. These findings are consistent with the concept of a humoral regulator of thrombocytopoiesis, the activity of which is related to the severity of depression of circulating platelets.

29698 Karyotypic abnormalities and clinical aspects of patients with multiple myeloma and related paraproteinemic disorders. Liang, W.; Hopper, J.E.; Rowley, J.D. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Cancer;* 44: No. 2, 630-644(Aug 1979).

Karyotypic abnormalities were detected in the malignant cells of 6 of 18 patients with multiple myeloma (MM). Six patients with benign monoclonal gammopathy, one with amyloidosis of immunoglobulin origin, and two with Waldenstroem's macroglobulinemia had normal karyotypes. All six MM patients with aneuploidy were in a group of 10 patients in an accelerated or relapse phase of their disease and four had high serum paraprotein levels when their abnormal karyotypes were detected. Five of the 6 MM patients with aneuploidy had received prior chemotherapy. Aneuploidy was not observed in 8 stable MM patients. Abnormalities of chromosome 14 were present in all 6 patients. A translocation between Nos. 11 and 14 was found in aneuploid cells of 2 patients who had plasma cell leukemia (PCL). A deletion of chromosome 6 was detected in 2 MM patients and a pericentric inversion of No. 6 was seen in the patient with PCL. Three of 4 MM patients had a nonrandom loss of one chromosome 8. Two other MM patients developed acute nonlymphocytic leukemia (ANLL) after the diagnosis of MM. Marrow cells of one patient showed a 5q- chromosome and a constitutional translocation involving Nos. 13 and 14 during the preleukemic stage; during the leukemic phase, the karyotype evolved to 50 chromosomes including extra chromosomes 1, 6, 8, 10, and 21 and a missing 7, in addition to the originally detected 5q- and the 13/14 translocation.The peripheral blood from the other patient was hypodiploid, with a missing chromosome 7 and a translocation between 3q and 9p. These patterns of chromosome change resemble those of ANLL rather than MM and are similar to the changes seen in ANLL after treated malignant lymphoma.

TRACER TECHNIQUES

29699 Odontomas in Peromyscus leucopus. Finkel, M.P. (Argonne National Lab., IL); Lombard, L.S.; Staffeldt, E.F.; Duffy, P.H. *J. Natl. Cancer Inst.;* 63: No. 2, 407-411(Aug 1979).

A colony of Peromyscus leucopus was established 15 years ago from animals trapped in the deciduous forest at Argonne National Laboratory, Argonne, Illinois. A roentgenographic survey of the skeletons of 189 of these untreated animals dying during a 13-month period disclosed 48 odontogenic growths in 21 of the mice. These growths were diagnosed on histopathologic examination as complex odontomas, the incidence of which was higher in males than in females. In this relatively small sample, these benign tumors appeared to be associated with youth rather than old age.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 29648, 29649, 29658, 29673, 29687, 29697, 29755, 29757

29700 (BNL—27870) Genetic influence on brain catecholamines: high brain norepinephrine in salt-sensitive rats. Iwai, J.; Friedman, R.; Tassinari, L. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1980. Contract AC02-76CH00016. 6p. (CONF-800585—1). NTIS, PC A02/MF A01.

From 7. scientific meeting of the International Society of Hypertension; New Orleans, LA, USA (11 May 1980).

Rats genetically sensitive to salt-induced hypertension evinced higher levels of plasma norepinephrine and epinephrine than rats genetically resistant to hypertension. The hypertension-sensitive rats showed higher hypothalamic norepinephrine and lower epinephrine than resistant rats. In response to a high salt diet, brain stem norepinephrine increased in sensitive rats while resistant rats exhibited a decrease on the same diet.

29701 (DOE/EV/00790—1) Development and function of membrane systems in plant tissue. Hanson, J.B. (Illinois Univ., Urbana (USA). Dept. of Botany). 15 Jun 1980. Contract AS02-76EV00790. 20p. NTIS, PC A02/MF A01.

Progress is reported in the investigation of ion transport mechanisms in corn roots and mitochondria. Results indicate that with mitochondria the H^+/K^+ antiporter is active in passive influx of KCl, and that the Cl^- gradient drives the swelling. Citrate uptake by corn mitochondria requires phosphate or sulfate as an activating cofactor, but malate does not appear to be required. In the root investigations, fusicoccin was found to relieve the block in H^+ efflux pumping caused by protein synthesis inhibitors. Fusicoccin also repolarizes the cells. Inhibition of H^+ efflux by the H^+ channel inhibitors, oligomycin and DCCD, can also be relieved or bypassed by fusicoccin. Nigericin, a H^+/K^+ exchanging antibiotic, will give partial release of the H^+ efflux block caused by protein synthesis inhibitors, repolarizing the cells, but in no other respect does it resemble fusicoccin. It will not restore the K^+ influx or growth inhibitions resulting from treatment with protein synthesis inhibitors.

29702 Mouse embryo attachment to substratum and interaction of trophoblast with cultured cells. Glass, R.H.; Spindle, A.I.; Peder-

sen, R.A. (Univ. of California, San Francisco). *J. Exp. Zool.;* **208**: No. 3, 327-335(Jun 1979).

Hatching, attachment, and trophoblast outgrowth of mouse embryos in vitro were examined as a model for implantation. Mouse embryos attached and grew out on glass cover slips that were partially covered with cultured mouse cells (L cells, liver cells, transformed JLS-V11 cells, and teratocarcinoma cells). Scanning electron microscopy showed that processes of these cells made contact with trophoblast, but there was no evidence of cell lysis or of phagocytosis of the cells by trophoblast. Time-lapse cinematography showed that after contact the cultured mouse cells retracted from the trophoblast, which then spread into the areas vacated by those cells. This suggests a means by which the trophoblast gains entry into the endometrium without destruction of maternal cells. Neuraminidase (100 or 250 units/ml) had no effect on attachment of mouse embryos to glass. However, attachment was inhibited by trypsin at concentrations of 0.25%, 0.025%, and 0.0025%. Treatment of early blastocysts with diazooxo-norleucine, an inhibitor of glycoprotein synthesis, decreased the number of embryos hatching from the zona pellucida; treatment at the late blastocyst stage decreased hatching to a lesser extent. Among the late blastocysts that did hatch, the number forming trophoblast outgrowths was lower than in controls. These results suggest that glycoproteins may be of importance for embryo hatching, attachment, and outgrowth.

29703 Accessory cell requirements for the generation of cytolytic T lymphocytes. Lutz, C.T.; Fitch, F.W. (Univ of Chicago, IL). Contract EY-76-C-02-0069. *J. Immunol.;* **122**: No. 6, 2598-2604(Jun 1979).

A system is presented that may simplify the study of accessory cell requirements for CTL generation. Cortisone resistant (CR) thymocytes containing alloreactive CTL precursors do not respond to allogeneic tumor cells unless non-T accessory cells are added to culture. In addition, splenic T cells do not respond to allogeneic tumor cells in the absence of non-T accessory cells. These accessory cells share several properties of macrophages.

29704 Spectral distribution of dimmed HID lamps in a plant growth facility. Bingham, G.E.; Coyne, P.I. (Lawrence Livermore Lab., CA). *Agron. J.;* **71**: 513-515(May 1979).

A commercial dimming ballast system for high intensity discharge (HID) lamps has been tested for use in plant growth chambers. The dimming ballast system can be controlled either manually at the dimming panel or by a d.c. voltage from a programmer or computer. Using the dimming system, photosynthetically active radiation can be continuously varied from about 200 to about 2000 $\mu E\ m^{-2}s^{-1}$. This paper shows the effects of dimming on the spectral intensity (400 to 750 nm) of three types of HID lamps measured individually and in combination to achieve a better spectral mix. The lamps used in this study were 400 w metal halide, mercury vapor and high pressure sodium.

29705 Time-resolved electron spin echo spectroscopy applied to the study of photosynthesis. Thurnauer, M.C.; Bowman, M.K.; Norris, J.R. (Argonne National Lab., IL). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **100**: No. 2, 309-312(Apr 1979).

A recent development in the research of photosynthesis has been the application of fast time-resolved electron paramagnetic resonance (EPR). The EPR method is particularly promising for systems which cannot readily be studied by optical techniques. The radicals which have been observed in photosynthetic systems by the magnetic resonance technique exhibit chemically-induced dynamic electron polarization (CIDEP). The mechanism which produces the spin polarization (a non-Boltzmann distribution of spin population) reflects the earlier fate of the radicals. The reported studies of photosynthetic systems by time resolved magnetic resonance have utilized what are not fairly standard EPR techniques. They have been limited by lack of adequate time resolution, possible distortions or artifacts due to the use of magnetic field modulation, and the problem of positively identifying the observed radical species. We are applying time-resolved electron spin echo (ESE) spectroscopy, a pulsed form of EPR, to the study of photosynthetic systems. This new technique not only avoids many of the problems described above but also provides several new advantages. We report here on the first observation of spin-polarized signals in the blue-green alga Synechococcus lividus using time-resolved ESE, and illustrate advantages of the technique.

29706 Effect of platelet age on adhesiveness to collagen and platelet surface charge. Castellan, R.M.; Steiner, M. (Pawtucket and Brown Univ., Providence, RI). *Thromb. Haemost.;* **36**: No. 2, 392-400(30 Nov 1976).

Adhesion to collagen was investigated as a function of platelet age in rat platelets. Platelet adherence was measured using EDTA-containing platelet- rich plasma which was added to preparations of collagen fibers clamped between magnetic stirrers by recording changes in light transmission. The plot of light transmission versus logarithm of time was linear and allowed calculation of a slope factor which related to the rate of adherence. Neither the amount of collagen nor the platelet count were limiting in the test. Young platelet populations (≦ 1 day old) were obtained during the recovery phase from immune induced thrombocytopenia. Old platelet populations were prepared by blocking thrombopoiesis with cyclophosphamide. Young platelets did not differ significantly from randomly aged platelets in this function. The electrophoretic mobility of platelets was not affected by their age.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 29675, 29689

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 28623, 29375

29707 (DOE/EV/04963—1) Competitive effects of introduced annual weeds on some native and reclamation species in the Powder River Basin, Wyoming. Allen, E.B.; Knight, D.H. (Wyoming Univ., Laramie (USA). Dept. of Botany). 1980. Contract AS02-78EV04963. 187p. NTIS, PC A09/MF A01.

Four experiments were conducted to examine the competitive effects of introduced annual weeds on certain native and reclamation species. The first experiment was initiated by discing three sites in the Powder River Basin, Wyoming, at three distances from introduced weed seed sources. Introduced weed colonization was greatest when a seed source was located nearby. Higher weed cover resulted in reductions of percent cover, density, and richness of the native species. The second experiment was conducted in the greenhouse and was designed to determine if there are changes in response of S. kali and the native grasses Agropyron smithii and Bouteloua gracilis to competition and water regime. Both grass species had lower biomass and higher stomatal resistance when growing in mixed culture with S. kali than in pure culture in the dry regime, but there were no significant differences in the wet regime. In general, the difference in plant response between mixed and pure cultures was more pronounced in the dry than in the wet regime. The third study was a greenhouse experiment on germination and competition of S. kali (a C_4 species) with native species Lepidium densiflorum (C_3), Chenopodium pratericola (C_3), A. smithii (C_3), and B. gracilis (C_4) under May, June, and July temperature regimes. Salsola kali germinated equally well in all three regimes, but the other C_4 species had highest germination in the July regime and the C_3 species in the May and June regimes. The fourth study was designed to examine the effect of weed colonization on the success of mine reclamation. Little effect was observed, but colonization by introduced annuals was very low. (ERB)

29708 Renewable resource management for forestry and agriculture. Bethel, J.S.; Massengale, M.A. (eds.). Seattle, WA; Univ. of Washington Press (1978). 130p. (CONF-770210—P1).

From A.A. advancement of science conference; Denver, CO, USA (20 Feb 1977).

An assessment of the current status of agricultural and forest resources in the United States and of prospects for the future is presented. Information is presented under the following chapter titles: meeting world requirements for food and fiber; land resources and quality of life; assessment of technology in food production; assessment of technology in fiber production; energy requirements in managing for food and fiber production; management of renewable material supply; and public policies affecting land devoted to agriculture and forests. (JGB)

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

29709 Perspective on numerical analysis of the diffusion equation. Narasimhan, T.N. (Univ. of California, Berkeley). *Adv. Water Resour.;* **1**: No. 3, 147-155(1978).

The equation of transient groundwater motion is founded on the principle of mass conservation, and can be mathematically described by the diffusion equation. Recently, powerful integral formulations have been developed for numerically solving the diffusion equation under complex conditions. In the literature, it is customary to formulate the integral equations by integrating point differential equations. This paper employs a direct method of formulation, starting from the concepts of set and measure, the notion of partition, and the definition of set-averages. When the direct approach is applied to formulate the well-known finite element (FEM) equations, it is seen that the Galerkin weighting function, which is mathemat-

ically treated as an artifice for weighting residuals, is but an appropriate spatial partition function. The logical framework of the direct approach is then applied to study the properties of lumped and consistent matrices arising in the use of the FEM. The lumped matrix, stemming naturally from the direct approach, seeks to conserve mass locally as well as globally, while the consistent matrix, which results only when the differential equation is integrated in a specific fashion, attempts only to preserve global mass balance. It is concluded that the direct approach is simple and complete and, in so far as the integral formulation is concerned, there is little to be gained in starting with the differential equation. Further, in formulating integral equations, it is common practice to evaluate only the time-dependent changes in the mass content of the system and ignore the evaluation of the mass content of the system at any given instant of time. In order to be complete in itself, a true integral approach should evaluate both the time-dependent changes in the mass content of the system and the instantaneous mass content at any given time. 6 figures.

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 29598

29710 (NDRL—2107) **Studies of radiation induced peroxidation in fatty acid micelles.** Patterson, L.K. (Notre Dame Univ., IN (USA). Radiation Lab.). 1980. Contract AC02-76ER00038. 9p. (CONF-800591—1). NTIS, PC A02/MF A01.

From International conference on oxygen and oxy-radicals in chemistry and biology; Austin, TX, USA (26 May 1980).

Studies of irradiation induced lipid peroxidation in fatty acid micelles, both from our own lab and others, are briefly summarized. Steady state measurements have shown the dependence of hydroperoxide yield on the state of aggregation in the lipid and the degree to which the reactive sites are close packed. Chromatographic measurements obeyed the square root dependence of yield on dose rate confirming the proposed chain mechanism. Application to antioxidant studies have demonstrated the highly efficient blockage of the peroxidation chain by α-tocopherol and the subsequent prooxidant effect of the product formed. Time resolved studies have been used to determine rate information for .OH-lipid interaction, radical transfer within the lipid, radical peroxidation, lipid radical movement across the micellar boundary, chain termination, and radical interaction with α-tocopherol. Complimentary laser studies have demonstrated, in contrast to .OH behavior, the comparatively high degree of selectively exhibited by alkoxy radicals toward allylic lipid sites.

29711 **Quaternary structure of methemoglobin.** Chevion, M.; Ilan, Y.A.; Samuni, A.; Navok, T.; Czapski, G. (Hebrew Univ., Jerusalem, Israel). Contract E(11-1)3221. *J. Biol. Chem.;* **254**: No. 14, 6370-6374(25 Jul 1979).

The pulse radiolysis of solutions of adult human methemoglobin was used to reduce a single heme iron within the protein tetramers. The valence hybrids thus formed were reacted with oxygen. Kinetics of the reactions were studied. The effects of pH and inositol hexaphosphate were examined. The kinetics of the ligation of oxygen to stripped valence hybrids showed a single phase behavior at the pH range 6.5 to 9. As the pH was lowered below 6.5, a second, slower phase became apparent. In the presence of inositol hexaphosphate, above pH 8, the kinetics of oxygen binding was of a single phase. As the pH was lowered, a transition to a second, slower phase was noticed. Below pH 7, the slower phase was the only detectable one. On this basis, it is concluded that human adult stripped methemoglobin resides in an R quarternary structure, while the presence of IHP stabilizes the T structure at pH below 7.5. This transition between the quaternary structures of methemoglobin cannot be accounted for by the switch between the high spin and the low spin states of the ferric iron. This switch of spin state takes place at pH$>$8.2.

IN MICROORGANISMS

29712 **Pyrimidine dimer excision in a Bacillus subtilis Uvr$^-$ mutant.** Hadden, C.T. (Oak Ridge National Lab., TN). Contract EY-76-S-05-4568. *J. Bacteriol.;* **139**: No. 1, 247-255(Jul 1979).

A technique which allows the measurement of small numbers of pyrimidine dimers in the deoxyribonucleic acid (DNA) of cells of Bacillus subtilis irradiated with ultraviolet light has been used to show that a strain mutant at the uvr-1 locus is able to excise pyrimidine dimers. Excision repair in this strain was slow, but incision may not be rate limiting because single-strand breaks in DNA accumulate under some conditions. Excision repair probably accounted for a liquid-holding recovery previously reported to occur in this strain. Recombinational exchange of pyrimidine dimers into newly replicated DNA was readily detected in uvr-1 cells, but this exchange did not account for more than a minor fraction of the dimers removed from parental DNA. Excision repair in the uvr-1 strain was inhibited by a drug which complexes DNA polymerase III with DNA gaps. This inhibition may be limited to a number of sites equal to the number of DNA polymerase III molecules, and it is inferred that large gaps are produced by excision of dimers. Because the uvr-1 mutation specifically interferes with excision of dimers at incision sites, it is concluded that the uvr-1 gene product may be an exonuclease which is essential for efficient dimer excision.

IN ANIMALS

REFER ALSO TO CITATION(S) 29722

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 29672, 29734

29713 (PNL—3300(Pt.1), pp 229-233) **Further characterization of the reverse transcriptase associated with porcine (radiation-induced) retroviruses.** Frazier, M.E.; Mallavia, L.P.; Hooper, M.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical Sciences.

Differential centrifugation and affinity chromatography were used to purify the porcine, radiation-induced retrovirus, RNA-dependent DNA polymerase. The purified RDDP was taken differentiated from cellular DNA polymerase γ by its template specificity, chromatographic characteristics, and the optimum reaction conditions required for DNA synthesis.

29714 **Vitamin E induces morphological differentiation and increases the effect of ionizing radiation on neuroblastome cells in culture (40598).** Prasad, K.N.; Ramanujam, S.; Gaudreau, D. (Univ. of Colorado Medical Center, Denver). *Proc. Soc. Exp. Biol. Med.;* **161**: No. 4, 570-573(Sep 1979).

Vitamin E increased the expression of morphological differentiation in mouse neuroblastoma (NBP_3) cells in culture, but it did not produce a similar effect in glioma cell culture (C-6). The extent of vitamin E-induced changes on NB cells was dependent upon cell density, drug concentration, and the frequency of change of growth medium and drug. Neuroblastoma cells were more sensitive to vitamin E than glioma cells for the criterion of growth inhibition (due to cell death and reduction in cell division). The combination of vitamin E and γ irradiation produced an additive effect on both NB and glioma cells for the criterion of growth inhibition; however, it produced an additive effect for the criterion of morphological differentiation only on NB cells.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

REFER ALSO TO CITATION(S) 29712

29715 (BNL—27923) **Haemophilus influenzae does not fit theories of postreplication repair.** Setlow, J.K.; Notani, N.K. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 5p. NTIS, PC A02/MF A01.

Studies with Escherichia coli have provided all the initial insights into the molecular bases of repair processes. It is the thesis of this article that especially if we believe that there are some general mechanisms in nature, it is important to consider more than one microorganism in arriving at an understanding of the biology of repair of DNA.

29716 **Deoxyribonucleic acid repair in Bacillus subtilis: development of competent cells into a tester for carcinogens.** Yasbin, R.E.; Miehl, R. (Pennsylvania State Univ., University Park). *Appl. Environ. Microbiol.;* **39**: No. 4, 854-858(Apr 1980).

The development of competent transformed Bacillus subtilis into a tester system for carcinogens is described. Precocious or noninduced activation of SOS functions occurs in competent cells. Thus, lower doses or concentrations of SOS inducing agents are needed to cause cell death due to indigenous prophage activation and lysis of bacteria. The two known defective prophages in B. subtilis enhance the sensitivity of competent cells to the carcinogens ultraviolet light, mitomycin C, and methyl methanesulfonate. However, these same cells have no enhanced sensitivity for the noncarcinogenic ethyl methanesulfonate or for nalidixic acid. Therefore, competent B. subtilis appears to be a sensitive tester for carcinogens.

29717 Gap-filling repair synthesis induced by ultraviolet light in a Bacillus subtilis Uvr⁻ mutant. Hadden, C.T. (Oak Ridge National Lab., TN). Contract EY-76-S-05-4568; W-7405-ENG-26. *J. Bacteriol.;* **139**: No. 1, 239-246(Jul 1979).

Deoxyribonucleic acid repair synthesis was studied in one wild-type and two mutant strains of Bacillus subtilis that are defective in excision of pyrimidine dimers. The cells were irradiated with ultraviolet light, and 6-(p-hydroxyphenyl-azo)-uracil was used to block replicative synthesis, allowing only repair synthesis. One of the mutations (uvs-42) resulted in a severe inhibition of incision, dimer excision, and repair synthesis. In contrast, the other mutant (uvr-1) slowly incised and excised dimers and did repair synthesis in patches which appear to be several-fold longer than those in the wild-type strain, apparently because large gaps are produced at excision sites. The results indicate that the primary defect in uvs-42 cells is in initiation of dimer excision, whereas the uvr-1 mutation appears to be a defect in the exonuclease normally used to complete dimer excision.

29718 Ultraviolet-induced reversion of cyc1 alleles in radiation-sensitive strains of yeast. III. rev3 mutant strains. Lawrence, C.W.; Christensen, R.B. (Univ. of Rochester, NY). *Genetics;* **92**: 394-408(Jun 1979).

The role of the REV3 gene function in uv-induced mutagenesis in the yeast Saccharomyces cerevisiae has been examined by determining the reversion of 12 well-defined cyc1 mutations in diploid strains homozygous for the rev3-1 or rev3-3 allele. The 12 cyc1 alleles include one ochre, one amber, four initiation, two proline missense, and four frameshift mutations. We find that the rev3 mutations reduce the frequency of uv-induced reversion of all of the cyc1 alleles, though different classes of alleles respond to a different extent. These results imply that the REV3 gene function is required for the production of a wide variety of mutational events, though probably not all, and show that each of the three REV loci have different mutational phenotypes. Such diverse phenotypes are not predicted by the unitary model for bacterial mutagenesis, suggesting that this is at best an imcomplete description of eukaryotic mutagenesis.

RADIATION EFFECTS ON ANIMALS

MAN

29719 (BNL—28065) **DNA damage and carcinogenesis.** Stelow, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 10p. NTIS, PC A02/MF A01.

Although cancer may arise as a result of many different types of molecular changes, there is little reason to doubt that changes to DNA are one of the more important ones in cancer initiation. Although DNA repair mechanisms seem able to eliminate a very large fraction of deleterious changes to DNA, we not only have little insight into the molecular mechanisms involved in such repair, but have a negligible amount of information to permit us to estimate the shape of dose response relations at low doses. The case of skin cancer is a special one, in that the average population is exposed to sufficient solar uv so that the effects of small increments in uv dose may be estimated. An approximate 85% reduction in DNA repair increases skin cancer incidence 10^4 fold.

29720 Role of radon on comparisons of effects of radioactivity releases from nuclear power, coal burning, and phosphate mining. Cohen, B.L. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* **33**: 155(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

VERTEBRATES

REFER ALSO TO CITATION(S) 29671

29721 (DP-MS—79-111) **Cesium-137 in deer: Savannah River Plant vs. southeastern coastal plain herds.** Watts, J.R.; Rabon, E.W.; Dicks, A.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract AC09-76SR00001. 17p. (CONF-800731—1). NTIS, PC A02/MF A01.

From Health Physics Society meeting; Seattle, WA, USA (20 Jul 1980).

The ^{137}Cs content in deer killed during programmed hunts at the Savannah River Plant (SRP) has averaged 9.0 pCi/g. This value, based on measurements of 13,907 deer taken over 14 years (1965 to 1978), similar to the value obtained for 552 deer from other southeastern Coastal Plain locations, indicating the ^{137}Cs content is due to fallout from the atmospheric testing of nuclear weapons rather than from SRP operations. The computerized SRP data base for each harvested deer includes age, sex, weight, cesium content, kill location, date, and the hunter's name. Analysis of these data enables the estimation of population dose from ingestion of the edible meat. Consumption of all edible meat from deer killed at SRP from 1965 to 1978 gives a whole body population dose of 196 man-rem from ^{137}Cs. Assuming an annual consumption rate of 20 kg gives an average individual whole body dose of 13 mrem, about 10% of local annual background level. The radiation dose from ^{40}K of natural potassium content of deer is comparable to the radiation dose from ^{137}Cs.

29722 Photoreactivating enzyme in the blind cave fish, Anoptichthys jordani. Woodhead, A.D.; Achey, P.M. (Brookhaven National Lab., Upton, NY). *Comp. Biochem. Physiol., B;* **63**: 73-76(1979).

Exposure of cells to ultraviolet light induces molecular changes in DNA which may lead to cellular death. One product, pyrimidine dimers, is reversed during subsequent exposure to visible light by photoreactivating enzyme. Photoreactivating enzyme has been recorded in different organisms, but inconsistencies in its distribution suggest it may have other functions. We have found photoreactivating enzyme in the blind cave dwelling fish, Anoptichthys jordani. Sufficient time has elapsed in the cave environment to allow loss of features of importance to epigean fish, including the eyes and pigmentation. The continued presence of the enzyme indicates that it may have other functions.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 29724, 29725

29723 (UCRL—84520) **Use of AERIN code for determining internal doses of transuranic isotopes.** King, W.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 13 Jun 1980. Contract W-7405-ENG-48. 16p. (CONF-800731—2). NTIS, PC A02/MF A01.

From Health Physics Society meeting; Seattle, WA, USA (20 Jul 1980).

The AERIN computer code is a mathematical expression of the ICRP Lung Model. The code was developed at the Lawrence Livermore National Laboratory to compute the body organ burdens and absorbed radiation doses resulting from the inhalation of transuranic isotopes and to predict the amount of activity excreted in the urine and feces as a function of time. Over forty cases of internal exposure have been studied using the AERIN code. The code, as modified, has proven to be extremely versatile. The case studies presented demonstrate the excellent correlation that can be obtained between code predictions and observed bioassay data. In one case study a discrepancy was observed between an in vivo count of the whole body and the application of the code using urine and fecal data as input. The discrepancy was resolved by in vivo skull counts that showed the code had predicted the correct skeletal burden.

RADIATION EFFECTS

ANIMALS

REFER ALSO TO CITATION(S) 29728, 29729, 29731

NUCLIDE KINETICS AND TOXICOLOGY

29724 Metabolism of americium-241 in man: an unusual case of internal contamination of a child and his father. Cohen, N.; Lo Sasso, T.; Wrenn, M.E. (New York Univ., Tuxedo). Contract EY-76-S-02. *Science;* **206**: 64-66(5 Oct 1979).

The metabolism of americium-241 has been studied during an 8-year period in an adult male and his son who, at the ages of 50 and 4 years, respectively, were accidentally and unknowingly contaminated within their home by means of inhalation. Chelation therapy with calcium trisodium pentetate was more effective in enhancing the removal of americium-241 from the child than from the father.

MAN

REFER ALSO TO CITATION(S) 29723

29725 (CONF-800427—13) **Estimation of dose to man from environmental tritium.** Rohwer, P.S.; Etnier, E.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic applications; Dayton, OH, USA (29 Apr 1980).

Factors important for characterization of tritium in environmental pathways leading to exposure of man are reviewed and quantification of those factors is discussed. Parameters characterizing the behavior of tritium in man are also subjected to review. Factors to be discussed include organic binding, bioaccumulation,

quality factor and transmutation. A variety of models are presently in use to estimate dose to man from environmental releases of tritium. Results from four representative models are compared and discussed. Site-specific information is always preferable when parameterizing models to estimate dose to man. There may be significant differences in dose potential among geographic regions due to variable factors. An example of one such factor examined is absolute humidity. It is concluded that adequate methodologies exist for estimation of dose to man from environmental tritium although a number of areas are identified where additional tritium research is desirable.

ANIMALS

29726 (BNL—27794) **Tumor uptake of radioruthenium compounds.** Srivastava, S.C.; Richards, P.; Meinken, G.E.; Larson, S.M.; Grunbaum, Z. (Brookhaven National Lab., Upton, NY (USA); Veterans Administration Hospital, Seattle, WA (USA)). 1980. Contract AC02-76CH00016. 13p. (CONF-800336—2). NTIS, PC A02/MF A01.

From Radiopharmaceuticals: structure activity relationships symposium; Hartford, CT, USA (21 Mar 1980).

The use of ruthenium-97 as a scintigraphic agent, particularly for tumor localization, is investigated. The tumor uptake of ruthenium chloride and ruthenium-labelled transferrin is evaluated and their application as tumor-imagine agents is compared to gallium-67 citrate. (ACR)

29727 (PNL—3300(Pt.1), pp 97-98) **Pulmonary distribution of inhaled $^{239}PuO_2$ in dogs.** McShane, J.F.; Dagle, G.E.; Park, J.F.; Catt, D.L. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical Sciences.

Dogs exposed to $^{239}PuO_2$ by inhalation were killed from 1 to 69 mo postexposure. The distribution of plutonium in the lungs, which was studied by analyzing autoradiographs, changed relative to time postexposure. This study investigates methods of measuring these changes.

29728 (PNL—3300(Pt.1), pp 118-119) **Carcinogenic effect of high-fired $^{241}AmO_2$.** Sanders, C.L. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical Sciences.

Inhaled $^{241}AmO_2$ was cleared from the lung with component half-lives of 0.5 days, 6.8 days, and several hundred days; histopathology studies are continuing.

29729 (PNL—3300(Pt.1), pp 180-182) **Late effects of ^{239}Pu administered at representative stages of gestation.** Andrew, F.D.; Sikov, M.R.; Dagle, G.E.; Carr, D.B. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical Sciences.

Prenatal exposure to ^{239}Pu depressed offspring growth and survival rates in a relatively dose-related fashion. Histopathological evaluations of the tumors and other lesions removed at necropsy are currently underway.

29730 (PNL—3300(Pt.1), pp 214-217) **Mixed chelation therapy for removal of plutonium and americium.** Smith, V.H.; Gelman, R.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical Sciences.

Iron-binding compounds, 2,3-dihydroxybenzoic acid (DHBA), 2-hydroxybenzoic acid (HBA), and 2-(acetyloxy)benzoic acid (ABA), were tested for their ability to remove americium and plutonium from rats following intraperitioneal injection of the radionuclides as citrates (pH 5). Treatments, 2 mmol/kg, were given on days 3, 6, 10, 12 and 14 following the actinide injection. DHBA and HBA caused about a 20% decrease in liver retention of americium compared to the control value, and DHB caused a similar effect for plutonium. The above agents, co-administered with 0.5 mmol polyaminopolycarboxylic acid (PAPCA)-type chelons, did not change tissue retention of americium and plutonium from that due to the PAPCAs alone. Administration of americium and plutonium to the same rats is useful for studying removal agents since the two actinides behave independently in their biological disposition and response to removal.

29731 **Metabolism and biological effects of the transplutonium elements.** Durbin, P.W. Contract W-7405-ENG-48. pp 739-896 of Handbook of experimental pharmacology. Eichler, O.; Farah, A.; Herken, H.; Welch, A.D. (eds.). New York, NY; Springer-Verlag (1973).

The metabolism and toxicity of the transplutonium elements (americium, curium) are discussed with emphasis upon radionuclide kinetics within mice, dogs, and humans.

MICROORGANISMS

REFER ALSO TO CITATION(S) 29696

VERTEBRATES

REFER ALSO TO CITATION(S) 29636

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 28374

CELLS

REFER ALSO TO CITATION(S) 29716, 29756

29732 (COO—4800-8) **Effects of chemical carcinogens on the susceptibility of C57BL/10 and (SJL/J x C57BL/10) F_1 hybrids to Friend leukemia virus.** Raikow, R.B.; OKunewick, J.P.; Magliere, K.C.; Brozovich, B.J.; Seeman, P.R. (Allegheny-Singer Research Corp., Pittsburgh, PA (USA). Cancer Research Labs.). 1980. Contract AS02-78EV04800. 13p. (CONF-800378—1). NTIS, PC A02/MF A01.

From Genetic control of natural resistance to infection and malignancy; Montreal, Canada (18 Mar 1980).

Under normal circumstances cells of C57BL/10 mice are resistant to infection by Friend leukemia virus (FLV). Pre-treatment by chemical carcinogens does not affect the susceptibility of C57BL/10 mice to FLV leukemogenesis. However, immunosuppression by cyclophosphamide or a congenitally athymic condition allows the replication of the LLV component of FLV to take place in these mice. F1 hybrids between C57BL/10 and SJL/J mice are also resistant to virus, although about twenty percent of these hybrids develop leukemia after massive doses of FLV. Unexpectedly, the F1 hybrid with the virus-sensitive SJL/J mother was more resistant than the F1 hybrid from the reciprocal cross. Pre-treatment of the F1 hybrid or SJL/J mice with chemical carcinogens, such as methyl methane sulfonate and benzo(a)pyrene, but not cyclophosphamide, increased the incidence of leukemia with a peak of increased susceptibility developing at a specific time after treatment. A chemical carcinogen-caused depression of the viability of hematopoietic cells in the spleen, which cells are the major target for FLV oncogenesis, was also temporally related with the increase in susceptibility to the virus. Our data correlated with information on the alleles known to affect resistance to murine leukemia viruses.

29733 **Distribution of cadmium in human blood cultured in low levels of $CdCl_2$: accumulation of Cd in lymphocytes and preferential binding to metallothionein.** Hildebrand, C.E.; Cram, L.S. (Univ. of California, Los Alamos, NM). *Proc. Soc. Exp. Biol. Med.;* **161**: No. 4, 438-443(Sep 1979).

Human blood was exposed to low levels of $CdCl_2$ (2 x 10/sup -7/ M) in tissue culture. During a 3-day exposure, Cd was accumulated by the blood cells. Erythrocytes incorporated Cd to a level ~ 5-fold greater than the concentration in the growth medium, while lymphocytes accumulated Cd to a cellular concentration ~ 3000-fold greater than that in the culture medium. In erythrocytes, Cd was bound to several macromolecular species, none of which corresponded to the specific, inducible, Cd-binding protein metallothionein.In contrast, most of the Cd in lymphocytes was found associated with a low-molecular-weight macromolecule characteristic of Cd-thionein. On the basis of these studies showing the accumulation of Cd by lymphocytes and the metabolic response of lymphocytes indicated by the sequestering of Cd in metallothionein, it is possible that Cd exposure may alter normal immunocompetence associated with lymphocytes.

29734 **Apparent decrease in thioTEPA-induced chromosome aberrations in human lymphocytes caused by an effect of WR2721 on the cell cycle as found by the definitively determined division method.** Wolff, S.; Arutyunyan, R. (Univ. of California, San Francisco). *Environmental Mutagenesis;* **1**: 5-13(1979).

Antimutagenic radioprotective compounds have been reported to decrease the yield of chemically induced chromosome aberrations even when administered long before the chemical mutagen thio-TEPA. Because thio-TEPA can induce aberrations in all parts of the cell cycle, it seemed likely that the apparent decrease in aberrations was the result of an effect of the antimutagen on the progression of cells through the cell cycle so that cells treated in the more sensitive stage would be scored. To test this possibility human lymphocytes were treated with the protective compound WR2721 and then thio-TEPA. The cells were grown in the presence of 5-

bromodeoxyuridine, which allows the definitive determination of metaphases from cells that divided once, twice, or three times after treatment. The yield of aberrations observed in first division cells was the same whether or not the protector was present. A decrease in aberration yields appeared only in rapidly cyling cells that were in the second division at the time of fixation. Labeling experiments showed that in this rapidly dividing population fewer of the metaphase cells had been in G_2 when thio-TEPA was added. The results indicate that part of the decrease in aberration yields obtained by treatment with an antimutagen several hours before the addition of a mutagen is an artifact of cell selection.

29735 Effects of thiol modification and Ca^{++} on agonist-specific state transitions of nicotinic acetylcholine receptor from Torpedo californica electroplax. Miller, J.V.; Lukas, R.J.; Bennett, E.L. (Univ. of California, Berkeley). *Life Sci.;* **24**: No. 20, 1893-1900(1979).

The agonist binding affinity of nicotinic acetylcholine receptor (nAChR) from Torpedo californica electroplax, as inferred from ability of agonist to inhibit specific curaremimetic neurotoxin binding to nAChR, is sensitive to the duration of exposure to agonist. The concentration of carbachol necessary to prevent one-half of toxin binding over a 30 min incubation with nAChR (K_{30}) is 10 μM when toxin and carbachol are simultaneously added to membrane-bound nAChR, and 3 μM when nAChR are pretreated with carbachol for 30 min prior to the addition of toxin. These alterations in agonist affinity may be mimicked by modification of nAChR thiol groups. Affinity of nAChR for carbachol is decreased following treatment with dithiothreitol (DTT). Dithio-bis-nitrobenzoic acid treatment of DTT-reduced membranes yields K_{30} values of 5 μM for carbachol, while N-ethylmaleimide treatment of DTT-reduced nAChR produces nAChR with reduced affinity for carbachol, reflected to K_{30} values of about 400 μM. In the absence of Ca^{++}, K_{30} values for carbachol binding to native and DTT-reduced nAChR are diminished 3 to 6 fold. These affinity alterations are not observed with d-tubocurarine (antagonist) binding to nAChR. Thus, Ca^{++} and the oxidation state of nAChR thiols appear to affect the affinity of nAChR for agonists (but not antagonists), and may therefore be related to agonist-mediated events in receptor activation and/or desensitization.

MICROORGANISMS

REFER ALSO TO CITATION(S) 29627

29736 Chemical mutagenesis by benzo[a]pyrene in Escherichia coli in the absence of any activating agents. Hass, B.S.; Webb, R.B.; Gambill, T.B. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Mutat. Res.;* **60**: 395-399(1979).

Benzo[a]pyrene (BP) is a well known carcinogen that is also known to be a mutagen to bacterial strains in the presence of liver microsomal activating systems or γ-radiation. To our knowledge, no one has reported benzo[a]pyrene to be significantly mutagenic in bacteria in the absence of activation of some kind. Using continuous culture techniques (chemostats) we have found BP to be significantly mutagenic to Escherichia coli B/sub s-1/ in the absence of exogenous activation.

29737 Mutagenicity of cyclic nitrosamines in Salmonella typhimurium: effect of ring size. Kameswar Rao, T.; Ramey, D.W.; Lijinsky, W.; Epler, J.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Mutat. Res.;* **67**: 21-26(1979).

Mutagenicity of cyclic nitrosamines with varying carcinogenic potentials was assayed in the Salmonella histidine-reversion system. Mutagenicity in the pourplate assay was compared with that in the liquid pre-incubation test. The smaller ring compounds (nitrosoazetidine, nitrosopyrrolidine, and nitrosopiperidine) exhibited a similar effect in both assays. The larger ring compounds (nitrosohexamethyleneimine, nitrosoheptamethyleneimine, nitrosooctamethyleneimine, and nitrosododecamethyleneimine) were more effective in the liquid pre-incubation test. Our results suggest a reasonable relationship between their mutagenic and carcinogenic activities.

PLANTS

REFER ALSO TO CITATION(S) 29586, 29593, 29632

29738 (CONF-800649—1) **Forest models: their development and potential applications for air pollution effects research.** Shugart, H.H.; McLaughlin, S.B.; West, D.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

From International symposium on effects of air pollutants on mediterranean and temperate forest ecosystems; Riverside, CA, USA (22 Jun 1980).

As research tools for evaluating the effects of chronic air pollution stress, forest simulation models offer one means of integrating forest growth and development data with generalized indices of pollution stress. This approach permits consideration of both the competitive interactions of trees in the forest stand and the influences of the stage of stand development on sensitivity of component species. A review of forest growth models, including tree, stand, and gap models, is provided as a means of evaluating relative strengths, weaknesses, and limits of applicability of representative examples of each type. Data from recent simulations with a gap model of eastern deciduous forest responses to air pollution stress are presented to emphasize the potential importance of competition in modifying individual species' responses in a forest stand. Recent developments in dendroecology are discussed as a potential mechanism for model validation and extended application.

29739 Simulated forest response to chronic air pollution stress. West, D.C.; McLaughlin, S.B.; Shugart, H.H. (ORNL). *J. Environ. Qual.;* **9**: No. 1, 43-49(Jan-Mar 1980).

A mathematical model, FORET, previously developed to examine successional dynamics of eastern deciduous forests was applied to a study of long-term interactions of air pollution stress and forest community dynamics. Differential levels of growth reduction were applied to trees in three pollution sensitivity classes to simulate changes in biomass of both individual species and the entire forest stand. The model predicts biomass increases of yellow poplar, white oak, black oak, and black cherry. (1 diagram, 9 graphs, 23 references, 1 table)

29740 Simulated forest response to chronic air pollution stress. West, D.C.; McLaughlin, S.B.; Shugart, H.H. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Qual.;* **9**: No. 1, 43-49(Jan 1980).

A mathematical model (FORET) previously developed to examine the successional dynamics of eastern deciduous forests was applied to the study of long-term interactions of air pollution stress and forest community dynamics. Differential levels of growth reduction (0, 10, and 20%) were applied to trees in three pollution sensitivity classes to simulate changes in biomass of both individual species and the entire forest stand. The response of individual species in a forest stand may differ markedly from results predicted on the basis of responses determined in the absence of plant competition. Some species may show growth enhancement in spite of pollutant stress, since they may gain a competitive advantage as a result of greater impacts on other species with which they interact in the successional process. Other species may experience much greater anticipated beneficial or injurious impacts due to reduced competitive potential. The results presented are intended to stress important considerations to be addressed in predicting the response of a forest to stresses such as air pollution. Responses described are not intended to be final quantitative answers.

29741 Interception and retention of simulated cooling tower drift (100-1300 . Taylor, F.G.; Parr, P.D.; Ball, F. (ORNL). *Atmos. Environ.;* **14**: No. 1, 19-25(1980).

An aerosol, characteristic of the drift from mechanical draft cooling towers, was produced by simulating the chemistry of the recirculating cooling water and generating droplets of known diameter sizes. The simulant was applied in a field study to determine the efficiency of aerosol interception by plants, and to estimate the retention efficiencies among several genera. Interception efficiencies were 72% for yellow poplar, 45% for loblolly pine, and 24% for fescue grass. Retention of aerosol drift on fescue foliage persisted for 8-12 wk. (3 graphs, 3 photos, 13 references, 3 tables)

INVERTEBRATES

REFER ALSO TO CITATION(S) 28395

29742 (COO—4580-2) **Investigating the impact of drilling mud and its major components on bivalve species of Georges bank. Progress report No. 2, February 28, 1979-November 1, 1979.** (New England Aquarium Corp., Boston, MA (USA)). 1 Nov 1979. Contract AS02-77EV04580. 90p. NTIS, PC A05/MF A01.

Results described in progress report No. 1 indicate that 0.3-1.0 grams of drilling mud/liter of seawater can stress bivalve molluscs and that metallic components of drilling muds are assimilated by these organisms. The results posed questions about the short- and long-term effects of stress on energy stores, reproduction, and metal assimilation; accordingly, this year's research program has focused on these three areas and on a continued chemical characterization of the drilling muds used.

29743 Field verification of cadmium toxicity to Laboratory Daphnia populations. Marshall, J.S. (Argonne National Lab., IL). *Bull. Environ. Contam. Toxicol.;* **20**: 387-393(1978).

The purpose of this paper is to compare the short-term toxicity of cadmium to laboratory populations of D. galeata mendotae with that to natural populations of D. galeata mendotae and total Daphnia in Lake Michigan, as indicated by its effects on the populations' rates of increase.

VERTEBRATES

REFER ALSO TO CITATION(S) 28395, 29755

29744 (BNL—27796) **Overview of ongoing oxidant research at Brookhaven National Laboratory.** Drew, R.T. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 11p. NTIS, PC A02/MF A01.

A brief description is given of research programs and facilities at Brookhaven National Laboratory involved with the health effects of oxidant air pollutants. (ACR)

29745 (BNL—27797) **Studies defining interactions between hypertension and air pollutants.** Drew, R.T.; Costa, D.L.; Haber, S.; Iwai, J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 11p. NTIS, PC A02/MF A01.

An animal model of hypertension was developed by breeding two lines of rats. The model was used to investigate interactions between commonly encountered air pollutants and the development of hypertension. This paper summarizes studies of the interaction of sulfur dioxide and ozone with the models. (ACR)

29746 (CONF-791002—7) **Chronic inhalation of cigarette tobacco smoke by rats.** Dalbey, W.E.; Nettesheim, P.; Griesemer, R.; Caton, J.E.; Guerin, M.R. (Oak Ridge National Lab., TN (USA); National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA); National Cancer Inst., Bethesda, MD (USA). Div. of Cancer Cause and Prevention). 1979. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

From 19. annual Hanford life sciences symposium; Richland, WA, USA (22 Oct 1979).

Specific-pathogen-free rats were exposed by inhalation to cigarette tobacco smoke in a regimen considered to result in a maximal tolerated dose. Total pulmonary deposition of smoke particulates from a single cigarette was 0.25 mg in young rats. Rats were exposed to smoke from 7 cigarettes per day for up to 2.5 years, at which time 30% of the exposed rats remained alive. Mortality of smoke-exposed animals was not different from that of untreated and sham-exposed controls. Nine percent of the exposed animals had tumors in the respiratory tract as opposed to only 1% tumor incidence among the control animals. Smoke exposure did not change the total percent of animals with at least one tumor at some site in the body. However, relative to controls, exposed rats had significantly fewer tumors in the hypophysis, hematopoietic-lymphoid system, uterus, and ovary and an increased number of tumors in the dermis in addition to the respiratory tract. Several non-neoplastic changes were observed throughout the respiratory tract. Hyperplastic and metaplastic areas were seen in the epithelium of the nasal turbinates, larynx, and trachea of exposed animals at death. Lungs of exposed rats contained areas of focal alveolitis.

29747 (PNL—3300(Pt.1), pp 1-3) **Biological effects of chronic inhalation of coal mine dust and/or diesel engine exhaust in rodents.** Karagianes, M.T.; Palmer, R.F.; Busch, R.H.; Phelps, D.W.; Frazier, M.E.; McClanahan, B.J.; Pelroy, R.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 1. Biomedical sciences.

Rats were killed at 4, 8, 16 and 20 mo after the start of exposures to inhaled high-CWP (coal workers' pneumoconiosis) bituminous coal mine dust separately, and combined with unscrubbed exhaust fumes from a diesel engine operated under load-rpm cycling. General health and hematologic parameters were normal. Lung lesions and accumulations of particulate matter increased with length and type of exposure. In vitro biological tests were performed on the diesel exhaust to determine toxic, mutagenic and/or carcinogenic activity. A general characterization of the diesel soot at three separate locations in the exposure system was also performed.

29748 **Chromium levels in fish from a lake chronically contaminated with chromates from cooling towers.** Elwood, J.W.; Beauchamp, J.J.; Allen, C.P. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Int. J. Environ. Stud.;* **14**: 289-298(1980).

Chromium concentrations of several fish species [bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides) goldfish (Carassius auratus), and mosquitofish (Gambusia affinis)] from White Oak Lake (WOL), a small impoundment which formerly received cooling water blowdown containing high Cr(VI) concentrations, were measured to determine levels of tissue accumulation. Chromium concentrations in the muscle and/or whole body (excluding G.I. tract) of some species in some years were found to be negatively correlated with total fish weight. Results suggest that Cr levels in muscle and whole body of most species analyzed from WOL and from Melton Hill Reservoir, an uncontaminated impoundment, may be inversely related to fish weight. Muscle and whole-body Cr concentrations were not significantly different from each other in bluegill or largemouth bass. With the exception of goldfish collected in 1969, between species comparisons of chromium levels in WOL fish within years showed no statistically significant differences, indicating that there was not trophic level effect on Cr accumulation in tissues of the species examined. There was also no significant difference in Cr concentration in muscle of bluegill and largemouth bass from WOL and Melton Hill Reservoir, indicating that these species either effectively regulate their Cr absorption or that the elevated Cr levels in WOL were in a form that is unavailable for absorption into tissues.

29749 **Distribution of mercury and selenium in egg components and egg-white proteins.** Magat, W.; Sell, J.L. (Iowa State Univ., Ames). *Proc. Soc. Exp. Biol. Med.;* **161**: No. 4, 458-463(Sep 1979).

Methylmercuric chloride (Hg) at 20 ppM and sodium selenite (Se) at 8 ppM were fed, separately and in combination, to laying hens. Oral doses of $CH_3{}^{203}HgCl$ and $H_2{}^{75}SeO_3$ also were given to all hens. The concentration of ^{203}Hg and ^{75}Se in egg white and egg yolk, and the distribution of the radioisotopes among proteins of egg white, were determined. The highest concentrations of ^{203}Hg were observed in egg white. The 8 ppM of dietary Se significantly increased the concentrations of ^{203}Hg in egg white when compared with a diet containing no added Se. At the same time, the addition of Se to the diet reduced ^{203}Hg in the egg yolk. ^{75}Se was found primarily in egg yolk, but 20 ppM dietary Hg significantly decreased ^{75}Se in the egg yolk and increased it in the egg whites. A significant Hg x Se interaction was observed for deposition of ^{75}Se in egg white. When dietary Hg was fed separately from dietary Se, ^{75}Se deposition was increased in the egg whites. More than 97% of the total ^{203}Hg in egg white was associated with ovalbumin. Similarly, total Hg was found in greatest quantities in ovalbumin, irrespective of the addition of dietary Hg or Se. The largest proportion of total ^{75}Se dose and the highest concentration of total Se per unit of protein occurred in globulin, especially when 8 ppM Se were fed. The data illustrate preferential binding of Hg by ovalbumin and of Se by globulin as compared with other major proteins of egg white.

29750 **Inhibition of phorbol ester-induced tumor promotion in mice by vitamin A analog and anti-inflammatory steroid.** Weeks, C.E. (Oak Ridge National Lab., TN); Slaga, T.J.; Hennings, H.; Gleason, G.L.; Bracken, W.M. Contract W-7405-ENG-26. *J. Natl. Cancer Inst.;* **63**: No. 2, 401-406(Aug 1979).

The effects of a vitamin A analog, TMMP ethyl retinoate (abbreviated Ro 10-9359), and an anti-inflammatory steroid, fluocinonone acetonide (abbreviated FA), given alone or together were studied in a two-stage carcinogenesis system. the phorbol ester 12-O-tetradecanoylphorbol-13-acetate (TPA) was used as the tumor promoter in a DMBA-initiated mouse skin system. Two stocks of female mice, which differ in their degrees of sensitivity to skin carcinogenesis, were used. A dose-dependent inhibition of carcinogenic expression, as determined by a decreased number of papillomas per animal, was observed in each mouse stock with the use of both FA and Ro 10-9359 were given alone. When FA and RO 10-9359 were given together, an enhanced effect on the lowering of tumor incidence was noted. FA effectively inhibited tumor formation in the sensitive mouse stock even when the steroid was given 1 day prior to TPA treatment under conditions of unusually high doses of initiator (DMBA) and/or promoter (TPA). These results suggest that both anti-inflammatory steroids and retinoids inhibit tumor promotion and can be effectively used as a combination regimen for increased chemopreventive response.

29751 **Inhalation bioassay chemistry-Walton Horizontal Smoking Machine for inhalation exposure of rodents of cigarette smoke.** Guerin, M.R. (Oak Ridge National Lab., TN); Stokely, J.R.; Higgins, C.E.; Moneyhun, J.H.; Holmberg, R.W. Contract W-7405-ENG-26. *J. Natl. Cancer Inst.;* **63**: No. 2, 441-448(Aug 1979).

Studies of experimental tobacco smoke carcinogenesis have suffered from the lack of a conveniently available and well-characterized device for exposing animals to tobacco smoke for inhalation. The Walton Horizontal Smoking Machine, a commercially available system designed to expose up to 20 mice to the smoke of a single cigarette, may fulfill this need. This system produced a uniform smoke aerosol of predictable concentration nd appropriate composition for cigarettes with high delivery of nicotine (40 mg total particulate matter, 2.6 mg nicotine, and 17 cm^3 carbon monoxide per cigarette) and with low delivery of nicotine (30 mg total particulate matter, 0.3 mg nicotine, and 17 cm^3 carbon monoxide). In this experiment C57BL and DBA/2Bd strains of mice were used. Limitations of the concept of exposing animals to standing smoke were defined.

29752 **Benzo[a]pyrene-serum: albumin/cysteine interactions: fluorescence and electron spin resonance studies.** Srinivasan, B.N.; Fujimori, E. (Boston Biomedical Research Inst., MA). Contract EE-77-S-02-4374. *Chem.-Biol. Interact.;* **28**: 1-15(1979).

The complex between bovine serum albumin (BSA) and benzo[a]pyrene (BaP) exhibits three different types of fluorescence. The visible fluorescence at 407, 431 and 458 nm is modified by the formation of both hydroxy-BaP derivatives and BaP products strongly bound to the protein. The ultraviolet fluorescence I is

characterized by a triple-peaked structural fluorescence with maxima at 340, 357 and 378 nm. Upon addition of mercaptoethanol, this ultraviolet fluorescence decreases. The ultraviolet fluorescence II appears at 380 nm and corresponds to that of pyrene-like products. When irradiated with ultraviolet (365 nm) light, both the ultraviolet fluorescence I and the visible fluorescence decreases. In the interactions of BaP with BSA, a new radical has also been found in addition to the known 6-oxo-BaP radical. When irradiated with ultraviolet (365 nm) light the signal intensity of the new radical species decreases, while that of 6-oxo-BaP increases. Upon addition of mercaptoethanol, the signal of the new radical also diminishes and is replaced by a single narrow signal. The mixture of BaP and cysteine kept at room temperature for one day in the dark produces both a six-line ESR spectrum and a broad ultraviolet fluorescence at 330 nm, which gradually decay in about one week. When BaP and cysteine are mixed at 65°C for several hours, little ultraviolet fluorescence and ESR signal are detected. The results indicate the formation of a BaP radical as an intermediate in the interaction of BaP with BSA and cysteine in the presence of oxygen and suggest the involvement of SH-groups in this interaction.

29753 Influence of age on cadmium absorption and toxicity. Sasser, L.B.; Jarboe, G.E.; Chertok, R.J.; Callaham, M.F. pp 78-81 of Cadmium symposium. Oak Ridge, TN; Comparative Animal Research Laboratory (1977).

From Cadmium symposium; Jena, Germany (1 Aug 1977).

In a recent review of heavy metal metabolism, Jugo concluded that metal absorption is generally enhanced in the young. Large increases in Cd retention have been observed in 1- to 3-wk-old mice and Kello and Kostial reported nearly 30% retention in 1-wk-old rats 6 days after dosing. These studies fail to distingush between Cd transfer (systematic absorption) and Cd retained in the gastrointestinal tract. The relative sensitivity of the young to Cd toxicity is confounded by data suggesting that the newborn absorbs Cd in much greater quantities and is more resistant to Cd toxicity than the adult. This paper is a summary of our results on Cd absorption and toxicity in the young rat.

MAN

REFER ALSO TO CITATION(S) 28418, 29733

29754 (CONF-800557—1) Separation and identification of mutagenic constituents of petroleum substitutes. Guerin, M.R.; Ho, C.H.; Rao, T.K.; Clark, B.R.; Epler, J.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From 10. annual symposium on the analytical chemistry of pollutants; Dortmund, F.R. Germany (28 May 1980).

A study combining chemical separations, mutagenicity testing, and spectroscopic identifications is underway to isolate and identify mutagens in coal- and shale-derived oils. Ether-aqueous partition combined with Sephadex LH-20 chromatography of the resulting neutral fraction is introduced as a preferred class fractionation procedure. The uniquely important role of polycyclic aromatic primary amines in the mutagenicity of petroleum substitutes is reviewed. Questions are raised concerning the role of polycyclic aromatic hydrocarbons in the mutagenicity of the neutral fraction of petroleum substitutes.

29755 (UR—3490-1845) Development of a model for the assessment of somesthetic sensitivity impairment in human and nonhuman primates: normative data and applications to the study of drugs and toxic chemicals. Maurissen, J.P.J. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract AC02-76EV03490. 113p. NTIS, PC A06/MF A01.

Thesis.

Numerous physical, chemical, and biological agents produce cutaneous sensory symptoms usually associated with peripheral nerve disorders. The exact nature of these neurotoxic effects was studied using a psychophysical approach which consists of the scientific study of the relations between stimuli and resulting cutaneous sensations. Vibration sensitivity which involves at least two different sets of end organs and nerve fibers was used to define cutaneous sensations. Several chemicals, such as acrylamide and methylmercury, can selectively cause partial loss of or damage to large myelinated fibers. Since vibrator information travels through such fibers, an insult of this nature could result in decreased vibratory sensitivity. A computerized system for the study of vibration sensitivity was designed and developed for use with both monkeys and humans. The system and experimental techniques are described. One human subject received several doses of carbocaine. The time course of the effects of the drug on vibration sensitivity was studied and a dose-effect curve obtained. Two monkeys received the drug misonidazole and showed a decreased vibration sensitivity. Patients receiving the same also displayed elevated thresholds after receiving high neurotoxic doses. Two other monkeys received methylmercury chronically. A decrease in vibration sensitivity occurred without any other detectable signs of intoxication. Changes in vibration sensitivity seem to be an early sign of poisoning. (ERB)

29756 Mutation of human cells by kerosene soot. Skopek, T.R. (Massachusetts Inst. of Tech., Cambridge, MA); Liber, H.L.; Kaden, D.A.; Hites, R.A.; Thilly, W.G. *J. Natl. Cancer Inst.;* 63: No. 2, 309-312(Aug 1979).

The polycyclic aromatic hydrocarbon fraction of a kerosene soot induced forward mutation in human diploid lymphoblasts when coincubated with coincubated with Sprague-Dawley rat liver postmitochondrial supernatant. Two components of the kerosene soot extract, benzo[a]pyrene (BP) and cyclopenta[cd]pyrene (CP), were also tested. BP was not mutagenic at the concentration found in the soot extract, although it was active at higher concentrations. The amount of CP present could account for approximately 8% of the total mutation observed with the soot. The results were compared to data obtained previously in a similar mutation assay in Salmonella typhimurium. the protocol described permits the facile assay of mutation at the hgprt locus in human lymphoblasts; such mutation is induced by compounds or complex mixtures requiring mixed-function oxygenase activity for metabolism to genetically active derivatives.

29757 Routes of exposure, dose, and metabolism of metals. Camner, P.; Clarkson, T.W.; Nordberg, G.F. pp 65-97 of Handbook on the toxicology of metals. Friberg, L. (ed.). Amsterdam, Netherlands; Elsevier/North-Holland Biomedical Press (1979).

When evaluating the potential adverse effects of metal exposure it is important to understand the mechanisms by which the metal is delivered from the source to the site of action in the human body. Where such mechanisms are a result of events taking place in the ecosystem, they will be dealt with mainly in Chapter 4. This chapter will focus on mechanisms and factors of importance for the uptake and distribution of metals when they contact the human organism. Since airborne metals occur most frequently as aerosols, a considerable part of the chapter will deal with factors of importance for aerosol deposition and absorption in the human lung. As regards the absorption of aerosols of metals, some general knowledge is available which is applicable for prediction of absorption mechanisms. Such knowledge is not available to the same extent either for other absorption routes or for factors governing distribution and excretion of metals. These aspects will therefore be dealt with more briefly. In parts of this chapter dealing in detail with particular questions (e.g., aerosols, metabolic models), original publications are referred to. In other parts original references are not given, since other chapters give further details. Some details on how the dose rate may influence mathematical models for dose-effect and dose-response relationships are discussed in Chapter 7. Such influence of dose rate may be sometimes explained by the rates for absorption, transport, biotransformation and excretion, which control the dose reaching the site of effect. These factors will be dealt with in this chapter.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

29758 Occupational health and radiation hazards. Michaelson, S.M. (Univ. of Rochester, NY). *Occup. Health Saf.;* 28-36(May 1979).

The authors discuss occupational health hazards for personnel due to laser, infrared, ultraviolet, and microwave radiations. Dose-response relationships and medical surveillance of occupational diseases are also discussed.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 28422, 28428, 28493, 28498, 29621

29759 (USGS—474-266) Review of geology and material property data in shallow alluvium, eastern Area 2, Nevada Test Site. Spengler, R.W.; Glanzman, V.M. (Geological Survey, Denver, CO (USA)). May 1980. Contract AI08-76DP00474. 48p. NTIS, PC A03/MF A01.

A review of available geophysical data for pre- and post-1971 drill holes in eastern Area 2, Nevada Test Site, shows relatively uniform physical properties within the upper 300 meters of unsaturated alluvium. Studies focused on lithologic variations, principally carbonate rich intervals and their distribution between drill holes in the area. Data reviewed suggest a higher proportion of carbonate at reference-point depths in the west-central part of the study area.

29760 **Application of geochemical kinetic data to ground-water systems: a tuffaceous-rock system in southern Nevada.** Claassen, H.C.; White, A.F. (Geological Survey, Denver, CO). *ACS Symp. Ser.;* No. 93, 771-793(1978).

Kinetic modeling was used to estimate the effective surface area of aquifer in contact with a unit volume of ground water for a composite saturated-unsaturated groundwater system in southern Nevada. This aquifer property, not obtainable by other means, is necessary for realistic modeling of solute transport in groundwater systems. The results of the kinetic modeling indicate that only a small part of the total interconnected power space is available for transport of water to the water table. The aquifer studied is composed of both vitric (glassy) and divitrified (crystalline) volcanic tuff of nearly identical chemical composition. Laboratory determination of mass-transfer rates from the vitric material to solution as functions of pH allowed a simulation of the cation composition of the natural water. Simulated results were improved considerably when the model was modified to take into account precipitation of the clay mineral, montmorillonite. Estimates of surface area per unit volume obtained from the kinetic model are about 3% of those obtained from the kinetic model are about 3% of those obtained independently from surface area measurements using the Braunauer, Emmett, and Teller equation. 8 figures, 4 tables.

GEOPHYSICS

VOLCANOLOGY

REFER ALSO TO CITATION(S) 29590

GEOPHYSICAL SURVEY METHODS

29761 (DOE/ET/27148—1) **Analytic comparison of time- and frequency-domain electromagnetic methods.** Stoyer, C.H. (Colorado School of Mines, Golden (USA). Dept. of Geophysics). 1980. Contract AS02-78ET27148. 128p. NTIS, PC A07/MF A01.

The time- and frequency-domain methods of electromagnetic geophysical prospecting are compared to determine the similarities and differences and to recommend system choices for particular field situations. Only the wire-loop configuration is considered, as this array is quite standard in geothermal prospecting. Comparisons are carried out using hardware and physical considerations, a large catalog of 3-layer model curves, 2D-3D model calculations, and by comparing Fourier transforms and layered inversions of field data from the Randsburg KGRA in California. The results generally indicate that frequency-domain methods offer better resolution and more practical hardware design for long-offset shallow applications. They also have a much better backup in terms of modelling tools for interpretation and history of experience. Transient methods are better suited for deeper probing, for both long- and short-offset applications. Frequency-domain methods are limited by the primary field, which is subject to distortion from near-surface inhomogeneities; this is also the case for early-time transients. Transient measurements in late time are limited by ambient electromagnetic noise and dynamic range of receiving equipment.

29762 (UCRL—84281) **Maximum entropy technique for electromagnetic or seismic inversion.** Bevensee, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1980. Contract W-7405-ENG-48. 5p. (CONF-800823—1). NTIS, PC A02/MF A01.

From URSI international symposium; Munich, F.R. Germany (26 Aug 1980).

A maximum entropy method (MEM) was applied to inversion of an underdetermined constitutive parameter (electrical conductivity, refractive index or reciprocal wave velocity) profile in a two dimensional region probed by ray data. In accord with the first Principle of Data Reduction, the probability of the distribution subject to measurement constraints and consistent totality of that parameter was maximized. An MEM algorithm is outlined and examples given of the inversion of synthetic ray data in a cell model of the earth. Computational properties of the algorithm relative to convergence, ray redundancy and noise in the ray data are described. The MEM was extended logically to include curved rays or to solve the more difficult problem of underground conductivity inversion from surface potential measurements. It is concluded that the examples of this particular MEM suggest an unsuspected capability for resolving two-dimensional parameter profile anomalies from a minimum of ray data.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 28402, 28488, 28489

29763 (DP-MS—80-16) **Studies of the subsurface effects of earthquakes.** Marine, I.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 37p. (CONF-800245—1). NTIS, PC A03/MF A01.

From Workshop on subsurface seismic studies; Seattle, WA, USA (20 Feb 1980).

As part of the National Terminal Waste Storage Program, the Savannah River Laboratory is conducting a series of studies on the subsurface effects of earthquakes. This report summarizes three subcontracted studies. (1) Earthquake damage to underground facilities: the purpose of this study was to document damage and nondamage caused by earthquakes to tunnels and shallow underground openings; to mines and other deep openings; and to wells, shafts, and other vertical facilities. (2) Earthquake related displacement fields near underground facilities: the study included an analysis of block motion, an analysis of the dependence of displacement on the orientation and distance of joints from the earthquake source, and displacement related to distance and depth near a causative fault as a result of various shapes, depths, and senses of movement on the causative fault. (3) Numerical simulation of earthquake effects on tunnels for generic nuclear waste repositories: the objective of this study was to use numerical modeling to determine under what conditions seismic waves might cause instability of an underground opening or create fracturing that would increase the permeability of the rock mass.

29764 (LBL—10080) **Packer injection test data from sites on fractured rock.** Snow, D.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 18p. NTIS, PC $5.50/MF $3.50.

Packer tests conducted in drill holes in fractured rocks at dam and tunnel sites are the primary data for characterizing permeabilities, fracture spacings, apertures, and porosities. A collection of data, numbering 5862 tests at 41 sites between the surface and 200 m depth in 12 different fractured crystalline rock types is reported on microfiche. In addition to the discharge and collar pressure, each entry records the angle and size of drill hole, the inclined depths to the top and bottom of the test interval, the depth to the static water level and the bottom of overburden. A summary of computed permeabilities, porosities, fracture spacings, and apertures averaged for several depth zons at each site are tabulated, and publications derived from the data are referenced.

29765 (USGS—474-310) **Preliminary analysis of physical-properties data characteristics of tunnel beds 3 and 4 in a part of Areas 4 and 7, Nevada Test Site.** Brethauer, G.E.; Muller, D.C.; Kibler, J.E. (Geological Survey, Denver, CO (USA)). Jun 1980. Contract AI08-76DP00474. 81p. NTIS, PC A05/MF A01.

Physical-property data for two lithologic units within the tunnel beds have been analyzed using the GRASP system (Geologic Retrieval and Synopsis Program). Quality of the data used in this study has been stringently examined. The properties show good uniformity and can be used to predict physical properties by extrapolation and interpolation for new sites, thus effecting substantial savings by reducing the collection of geologic and geophysical data.

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 29438, 29514

29766 (DOE/EV/00889—T2) **Hydrographic observations off Savannah and Brunswick, Georgia, March, May and September 1977 and January 1978.** Singer, J.J.; Atkinson, L.P.; Chandler, W.S.; Bishop, S.S. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1978. Contract AS09-76EV00889. 110p. NTIS, PC A06/MF A01.

Seasonal onshore-offshore sections were run in March, May and September 1977 and January 1978 off Savannah and Brunswick, Georgia. In each instance upwelling was observed at the shelf break with significant nutrient fluxes into the surface and/or shelf waters. There are indications that eddies may have been responsible for some of these observations.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

29767 (LBL—10934) **Polarization of the cosmic background radiation.** Lubin, P.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 95p. NTIS, PC A05/MF A01.

Thesis.

The results and technique of a measurement of the linear polarization of the Cosmic Background Radiation are discussed. The ground-based experiment utilizes a single horn (7° beam width) Dicke-type microwave polarimeter operating at 33 GHz (9.1 mm). Data taken between May 1978 and February 1980 from both the northern hemisphere (Berkeley Lat. = 38°N) and the southern hemisphere (Lima Lat. = 12°S) show the radiation to be essentially unpolarized over all areas surveyed. For the 38° declination data the 95% confidence level limit on a linearly polarized component is 0.3 mK for the average and 12 and 24 hour periods. Fitting all data gives the 95% confidence level limit on a linearly polarized component of 0.3 mK for spherical harmonics through third order. Constraints on various cosmological models are discussed in light of these limits.

29768 Cosmic-ray-produced radiation fields in the environment. O'Brien, K. (Dept. of Energy, New York, NY). *Trans. Am. Nucl. Soc.;* **33**: 671-672(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

STARS

REFER ALSO TO CITATION(S) 29857

29769 (UCRL—84544) **Models for Type I supernovae.** Woosley, S.E.; Weaver, T.A.; Taam, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jun 1980. Contract W-7405-ENG-48. 19p. (CONF-800480—3). NTIS, PC A02/MF A01.

From ASCOT program planning meeting; Gettysburg, PA, USA (15 Apr 1980).

Two rather disjoint scenarios for Type I supernovae are presented. One is based upon mass accretion by a white dwarf in a binary system. The second involves a star having some 8 to 10 times the mass of the sun which may or may not be a solitary star. Despite the apparent dissimilarities in the models it may be that each occurs to some extent in nature for they both share the possibility of producing substantial quantities of ^{56}Ni and explosions in stars devoid of hydrogen envelopes. These are believed to be two properties that must be shared by any viable Type I model.

29770 Iterative treatment of double-mode pulsation. Simon, N.R. (Theoretical Division, Los Alamos Scientific Laboratory, University of California). *Astrophys. J.;* **237**: No. 1, 175-186(1 Apr 1980).

The iterative nonlinear pulsation theory is extended to the bimodal case, and a series of equations derived which are complete to second order. Solutions to these equations are obtained for a number of long-period double-mode Cepheid models in the vicinity of th interaction resonance $\omega_1+\omega_0=\omega_3$ and the harmonic resonance $P_3/P_0=0.5$. We show that the resonant second-order amplitudes and phases change abruptly as the center of the resonance is approached. In addition, it is demonstrated that, inward of the hydrogen ionization zone, the amplitudes strongly resemble the linear eigenfunctions to which they are resonantly linked. Thus the resonances are shown to have spatial as well as temporal content. Due to nonadiabatic effects the second-order terms are particularly strong in the H I ionization zone, a circumstance which suggests that this region could play an important role in determining limiting-amplitude behavior.

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 29919

COSMOLOGY

REFER ALSO TO CITATION(S) 29767

ATMOSPHERIC PHYSICS

MAGNETOSPHERIC PHENOMENA

29771 Macroscopic profile of the typical quasi-perpendicular bow shock: Isee 1 and 2. Greenstadt, E.W.; Russell, C.T.; Gosling, J.T.; Bame, S.J.; Paschmann, G.; Parks, G.K.; Anderson, K.A.; Scarf, F.L.; Anderson, R.R.; Gurnett, D.A.; Lin, R.P.; Lin, C.S.; Reme, H. (Space Sciences Department, TRW Defense and Space Systems Group, Redondo Beach, California 90278). *J. Geophys. Res.;* **85**: No. A5, 2124-2130(1 May 1980).

Field and particle properties of the bow shock recorded on November 5, 1977, identified earlier as stable features by comparison of Isee 1 and 2 data, are examined macroscopically. The extent to which the shock was in a 'typical' state is described, and multidiagnostic observations are combined to define the shock profile, which, in this known case, is reminiscent of composite portraits assembled from earlier studies. A foot, a principal wave front gradient, and a postfront overshoot characterized the magnetic field. Various particle measurements revealed corresponding structural elements, including a bimodal ion energy distributin whose two peaks were at roughly the solar wind streaming energy and 2 to 3 times the streaming energy. The electrons were thermalized before the principal sharp magnetic gradient; the ions were partially randomized at the gradient, but the ion thermalization process was not completed until long after the gradient was crossed. The second peak of the ion distribution represented a separate group of reflected particles upstream of the main magnetic gradient that retained its identity for an appreciable distance behind the front before being merged by thermalization into the general distribution. This separation group included a northward proton flux in front of, but not immediately behind, the front. The group ultimately became thermalized through a series of very regular oscillations. The decrease in solar wind bulk velocity at the fron exceeded the sum of that calculated from an idealized first-order model of the rise in potential opposing the flow, plus the proton heating, leaving proton reflection and wave radiation and dispersion as candidates to account for the discrepancy. Plasma wave activity, at ion acoustic frequencies, was most intense in the foot and at the front and appeared to be enhanced at the outer boundary of the reflected particles.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

29772 (CONF-7910122—13) **Electron beam experiments at Maryland University.** Brennan, M.A.; Loschialpo, P.; Namkung, W.; Reiser, M.; Lawson, J.D. (Maryland Univ., College Park (USA). Computer Science Center). 1979. Contract AS05-78ER05940. 8p. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

An experimental study of the stability of intense electron beams is described. The purpose is to determine the emittance growth associated with aberrations arising from the non-uniform transverse density distribution in the beam, and to compare measurements with the results of computer simulations. (GHT)

29773 Incident ion energy dependence of the secondary photon emission of ion bombarded beryllium. Wright, R.B.; Gruen, D.M. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **73**: No. 2, 664-672(15 Jul 1980).

Secondary photon emission due to ion bombardment of Be metal foil by 200—3000 eV Kr^+, Ar^+, Ne^+, O^+_2, and N^+_2 was studied and the emission yield from four Be (I) and one Be (II) transitions as a function of incident ion energy was interpreted in terms of relevant excitation processes. A model based on a velocity dependent excitation process, the random linear collision cascade theory of sputtering; and making allowance for nonradiative deexcitation of the excited sputtered atoms and/or ions, accounted for the observed energy dependent emission yields. The results of this model indicate that the secondary photon emission yield, Y/sup ex// sub i/(v/sub m/), of a given emission line, i, can be expressed as Y/ sup ex//sub i/ (v/sub m/) α J(μamp/cm²) S(no./ion) exp[-(A/a)/ sub i//v/sub m/], where J is the incident ion current density, S the sputtering yield; v/sub m/ is the velocity corresponding to the maximum transferred energy between the incident ion of energy E_1, mass M_1, and the target atom of mass M_2, i.e., v/sub m/=$8M_1E_1/(M_1+M_2)^2$]/sup 1/2/; (A/a)/sub i/ is the effective nonradiative deexcitation parameter for state i. Values for the (A/a)/sub i/ parameters were found to be 1—3 x 10^7 cm/sec for the Be (I) and Be (II) states; a decrease to 5—7 x 10^6 cm/sec upon O^+_2 bombardment was observed for the Be (I) states, while the value for the Be (II) state did not change.

ATOMIC AND MOLECULAR PROPERTIES

29774 (LA-UR—80-1712) **Techniques with H^0 produced from polarized H^- beams.** van Dyck, O.B.; Jason, A.J.; Hudgings, D.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800824—9). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

It is possible to perform useful manipulations by making H^0 beams from polarized H^- beams with stripper foils or stripping magnets. The hyperfine interaction modifies the behavior of the proton polarization in H^0, producing both useful and unwanted effects. Some depolarizing effects can be minimized.

29775 Temperatures from rotational-vibrational Raman Q-branches. Hill, R.A.; Mulac, A.J.; Aeschliman, D.P. (Sandia Labs., Albuquerque, NM). *J. Quant. Spectrosc. Radiat. Transfer;* **21**: 213-220(1979).

An iterative, least-square anaysis scheme, based on the differential of the intensity, dI = d tau ∂I/∂ tau + d rho ∂I/∂ rho, was

developed for obtaining the temperature, $\theta = 1/\tau$, and density, θ from a set of rotational-vibrational Raman, Q-branch intensities. Spectral locations that cover the maximum variation in $\partial I/\partial \tau$ were determined from a set of computed intensities and derivatives. The results for the Stokes (anti-Stokes) bands indicate for temperatures less than 2100°K (2700°K) that the maximum extent of $\partial I/\partial \tau$ can be spanned by recording intensities only in the first two vibrational bands, $\nu(1 - 0)$ and $\nu(2 - 1)$ and because of the multivalued nature of $\partial I/\partial \tau$, equally spaced values for $\partial I/\partial \tau$ can be obtained only by programing the spectrometer to select an appropriate set of non-uniformly space passbands. 6 figures, 1 table.

29776 On the possibility of calculating Siegert eigenvalues for autoionizing electronic states. Isaacson, A.D.; McCurdy, C.W.; Miller, W.H. (Univ. of California, Berkeley). *Chem. Phys. (Amsterdam);* **34**: 311-317(1978).

The energy lifetimes of metastable states (equivalently, the positions and widths of scattering resonances) are determined by the complex poles of the S-matrix, the Siegert eigenvalues. A variational, basis set method proposed by Bardsley and Junker for calculating these complex eigenvalues has been applied to several examples - a one-dimensional potential resonance and several autoionizing states of He and H^- - with encouraging results. The method is seen to converge to the correct results as the basis set is increased, and the convergence is seen to be well-behaved. It is also significant that results of useful accuracy (e.g., lifetimes to $\simeq$ 10% accuracy) can be obtained with reasonably modest basis sets ($\simeq$ 10 configurations for He, H^-), of a quality that is attainable for systems with more than two electrons.

COLLISION PHENOMENA

29777 (ATR—80(7783)-1) **Laser excited nonresonant fluorescence spectroscopy. Second annual progress report.** Gelbwachs, J.A.; Frueholz, R.P. (Aerospace Corp., El Segundo, CA (USA)). 30 Jun 1980. Contract AM03-76SF01101. 45p. NTIS, PC A03/MF A01.

The relative populations of numerous tin levels populated by collisional energy transfer from an initially laser pumped level were obtained. These populations yield information concerning the relative rates of energy transfer for the various buffer gases studied. The results indicated two distinct energy transfer behaviors. First, for certain tin levels diatomic collision partners produce populations nearly two orders of magnitude higher than when rare gases are present. This behavior is attributed to the effects of near-resonant energy transfer pathways for the $E \rightarrow V/R$ and $V/R \rightarrow E$ processes found in the diatomic collision partners. Second, for other tin levels, diatomics and rare gases transfer population approximately at the same rates and more efficiently than in the former case. For these levels the near-resonant pathways can be obscured by means of a more effective energy transfer channel common to both diatomics and rare gases such as by curve crossing mechanisms.

29778 (CONF-800579—1) **Low energy electron capture by multicharged ions from hydrogen.** Phaneuf, R.A.; Crandall, D.H.; Meyer, F.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From 2. technical committee meeting on atomic and molecular (a+m) data for fusion; Paris, France (19 May 1980).

In order to systematically investigate the behavior of low energy electron capture cross sections, the cross sections were measured for Xe^{2+} - Xe^{12+}, Ar^{2+} - Ar^{8+}, and Fe^{2+} - Fe^{6+} in H and H_2 for $3 < E < 26$ keV/charge, and for C^{2+} - C^{6+} in H_2 for $0.15 < E < 0.45$ keV/charge. (GHT)

29779 Radiative lifetimes and two-body collisional deactivation rate constants in argon for Kr(4p ^{5}5p) and Kr(4p ^{5}5p′) states. Chang, R.S.F.; Horiguchi, H.; Setser, D.W. (Department of Chemistry, Kansas State University, Manhattan, Kansas 66506). *J. Chem. Phys.;* **73**: No. 2, 778-790(15 Jul 1980).

The radiative lifetimes and collisional deactivation rate constants, in argon, of eight Kr(4p^5[^{2}P/sub 1/2/]5p and [^{2}P/sub 3/2/]5p) levels have been measured by a time-resolved laser-induced fluorescence technique in a flowing afterglow apparatus. The measured radiative lifetimes are compared with other experimental values and with theoretical calculations. Radiative branching ratios of these excited states also were measured in order to assign the absolute transition probabilities of the Kr(5p,5p′—5s, 5s′) transition array from the radiative lifetimes. In addition to the total deactivation rate constants, product states from two-body collisions between Kr(5p and 5p′) atoms and ground state argon atoms were identified from the laser-induced emission spectra, and product formation rate constants were assigned. Two-body intermultiplet transfer from Kr(4p^5[^{2}P/sub 1/2/]5p) to the Kr(4p^6[^{2}P/sub 3/2/]4d) levels occurs with ease. Intermultiplet transfer from the lowest level in the (4p^{5}5p) configuration to the Kr(4p^{5}5s and 5s′) manifold was fast despite the large energy defect. However, this was the only Kr(5p) level that gave appreciable transfer to the Kr(5s or 5s′) manifold. Generally the favored product states are within a few kT of the entrance channel.

29780 Stopping power for partially stripped ions. Kim, Y.; Cheng, K. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., A;* **22**: No. 1, 61-67(Jul 1980).

The Bethe formula for the stopping power for bare ions is extended to the collisions between partially stripped ions and neutral atoms. The resulting formulas can be presented in the same form as the original Bethe formula by replacing the nuclear charge of the projectile Z and the mean excitation energy I by Z/sub eff/ and I/sub eff/, respectively. Both Z/sub eff/ and I/sub eff/ contain contributions from excitations (including ionizations) of the target by the projectile, excitations of the projectile by the target, and mutual excitations. They are defined in terms of projectile and target properties that can be calculated from first principles. Expressions for Z/sub eff/ and I/sub eff/ reduce to those in the Bethe formula for bare incident ions. Formulas for atom-atom and ion-ion collisions are also presented. Comparison with experimental data on Ar ions in Ar gas indicates that the new formula is reliable for projectile energies greater than a few MeV/amu.

29781 Improved atomic model for charge transfer in multielectron ion-atom collisions at intermediate energies. Lin, C.D.; Tunnell, L.N. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Phys. Rev., A;* **22**: No. 1, 76-85(Jul 1980).

Electron capture to the K shell of projectiles from the K and other subshells of multielectron target atoms is studied in the intermediate energy region using the single-active-electron approximation and the two-state, two-center atomic eigenfunction expansion method. It is concluded that the theoretical capture cross section is not sensitive to the atomic models used at high collision energies where the projectile velocity v is near or greater than the orbital velocity v/sub e/ of the active electron. For $v < v/sub e/$, however, a proper atomic potential such as the Herman-Skillman potential is needed to represent the target atom. The insufficiency of various simple Coulomb model potentials is illustrated. Capture cross sections for a few collision systems are obtained and compared with experimental data when available to illustrate the reliability of the present model.

ATOMIC AND MOLECULAR THEORY

29782 Significance of time-reversal symmetry for time-resolved measurements of hydrogenic and other atomic observables. Gabrielse, G. (University of Chicago, Chicago, Illinois 60637). *Phys. Rev., A;* **22**: No. 1, 138-148(Jul 1980).

Time-resolved measurements of atomic observables are analyzed using a Liouville space formulation and a Hermitian unit tensor base. This approach makes it possible to distinguish cleanly the symmetries of a formation and/or excitation process completed by time t=0, a time evolution under experimental control between t=0 and t=t, and a measurement at t=t, even for hydrogenic observables. Each observable is labeled by a time-reversal quantum number, allowing exploration for the first time of the close relationship between time-reversal symmetry and the time evolution of atomic observables. The experimental reconstruction of atomic observables (at t=0) from subsequent time-resolved measurements of the anisotropy and polarization of emitted electric dipole photons is discussed. Hydrogenic observables are stressed and the use of strong fields is included, thus generalizing Fano and Macek's approach.

29783 Formal theory of effective π-electron Hamiltonians. Brandow, B.H. (Los Alamos Scientific Lab., NM). *Int. J. Quant. Chem.;* **15**: 207-242(1979).

The goal of developing a satisfactory general formalism for the justification of effective π-electron Hamiltonians, as well as for ab initio calculation of their parameters (α, β, and γ), has now been achieved. The need for a fully linked many-body formalism is emphasized; this feature requires a Rayleigh-Schroedinger (RS) type of degenerate perturbation theory. A number of apparently different degenerate RS perturbation formalisms are reviewed. Most of these formalisms are actually identical term-by-term, when their RS expansions are worked out explicity; the formal relations that prove their complete equivalence are presented and discussed. One of these formalisms, a version developed by the author for related open-shell problems in nuclear physics, is shown to be most convenient for many-body applications. This is owing to the relatively simple and transparent nature of its general algerbraic structure, which facilitates partial summation to infinite order. A simple and concise derivation is presented for the algerbraic features of this prefered formalism, and its many-body (linked cluster) aspects are briefly discussed. The recent development of a nonperturbative (coupled-cluster) analog of this formalism is also described. Some practical issues are examined, including the choice of orbital basis. Illustrative numercial results are presented, based on the calculations of Iwata and Freed. Several remaining problems are described; these are both qualitative and quantitative in nature, and their resolution will require some detailed calculations.

FLUID PHYSICS

GENERAL FLUID DYNAMICS

29784 (LA-UR—80-1631) **Fractional volume of fluid method for free boundary dynamics.** Nichols, B.D.; Hirt, C.W.; Hotchkiss, R.S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800661—2). NTIS, PC A02/MF A01.

From 7. international conference on numerical methods in fluid dynamics; Palo Alto, CA, USA (23 Jun 1980).

The volume of fluid (VOF) technique is presented as a simple and efficient means for numerically treating free boundaries embedded in a calculational mesh of Eulerian or Arbitrary-Lagrangian-Eulerian cells. It is particularly useful because it uses a minimum of stored information, treats intersecting free boundaries automatically, and can be readily extended to three-dimensional calculations.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

29785 (BNL—27943) **Multiplicity measurements in hadron reactions at 100 and 175 GeV.** Aitkenhead, W.; Barton, D.S.; Brandenburg, G.W. (Massachusetts Inst. of Tech., Cambridge (USA); Bari Univ. (Italy); Fermi National Accelerator Lab., Batavia, IL (USA); Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 56p. (CONF-800724—5). NTIS, PC A04/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Portions of document are illegible.

Charged particle multiplicities in the reactions a + p → c + x, where a and c are either π^{+-}, K^{+-}, p, or anti p were measured. The data were taken using the Fermilab Single Arm Spectrometer Facility and a nonmagnetic vertex detector. The average number of charged secondaries and their angular distribution are studied as functions of x and p/sub T/ of the scattered particle, c. Data are also presented on the total charged multiplicity for the reactions a + p → X.

29786 (LA-UR—80-1709) **Measurement of K/sub NN/ and K/sub LL/ in p vector p → n vector X at 800 MeV.** Bhatia, T.S.; Glass, G.; Hiebert, J.C. (Texas A and M Univ., College Station (USA); Texas Univ., Austin (USA); Rice Univ., Houston, TX (USA); Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—1). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The spin transfer parameters, K/sub NN/ and K/sub LL/ have been measured in p vector p → n vector X at 0° and 800 MeV for neutron momenta between 700 and 1200 MeV/c. Peak values of K/sub NN/ and K/sub LL/ are -.3 +- .05 and -.5 +- .1, respectively.

WEAK INTERACTIONS

29787 (BNL—27944) **A-dependence of inclusive hadron scattering at 100 GeV. Fermilab-Conf-80/47-Exp.** Brenner, A.E.; Carey, D.C.; Elias, J.E. (Fermi National Accelerator Lab., Batavia, IL (USA); Brown Univ., Providence, RI (USA); Bari Univ. (Italy). Ist. di Fisica; Massachusetts Inst. of Tech., Cambridge (USA); Institute of Nuclear Research, Warsaw (Poland)). 1980. Contract AC02-76CH00016. 20p. (CONF-800724—3). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

An experiment was performed to study the inclusive processes $a^+ + A \rightarrow c^{+-} + X$, where a and c are either π, K, or p. The nuclear targets used were C, Al, Cu, Ag, and Pb. The Feynman x and p/sub T/ dependence of particle c was studied using the Fermilab Single Arm Spectrometer. In this paper cross sections are presented as a function of x at transverse momenta of 0.3 and 0.5 GeV/c for each target nucleus. The A-dependence is parameterized as σ/sub A/ = σ_0A/sup α/, and the x-dependence of α is studied.

29788 (COO—3130-2) **How well do we know the quantum numbers of possible anti p p → M_1M_2 states.** Lanou, R.E. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1979. Contract AC02-76ER03130. 33p. (CONF-7906176—1). NTIS, PC A03/MF A01.

From Workshop on baryonium and multiquark states; Orsay, France (21 Jun 1979).

Information is available to completely analyze the p anti p → $\pi\pi$ reaction, allowing more global, large-scale, phenomenological analyses which combine the two experimental data sets in an energy independent, amplitude analysis which also includes pion-nucleon data. It would appear from the preliminary analyses of p anti p → M_1M_2 angular distributions and polarizations the T-region may indeed contain some very interesting activity. (GHT)

29789 (DOE/ER/01545—281) **Measurement of charmed particle lifetimes.** Reay, N.W. (Ohio State Univ., Columbus (USA)). 1980. Contract AC02-76ER01545. 13p. NTIS, PC A02/MF A01.

Recent measurements of charmed particle lifetimes are reviewed, and the lifetime measurements of Fermilab experiment 531 are presented in detail.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 29518, 29527, 29550

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 29527, 29550

29790 **Measurement and partial-wave analysis of the reaction $K^-p \rightarrow K^0$/sub S/$\pi^+\pi^-n$ at 6 GeV/c.** Etkin, A.; Foley, K.J.; Goldman, J.H.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Ozaki, S.; Platner, E.D.; Saulys, A.C.; Wheeler, C.D.; Willen, E.H.; Lindenbaum, S.J.; Kramer, M.A.; Mallik, U. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **22**: No. 1, 42-60(1 Jul 1980).

We have performed a partial-wave analysis of the reaction $K^-p \rightarrow K^0$/sub S/$\pi^+\pi^-n$ at 6 GeV/c. We present the results of the analysis of about 4500 events in the low-t region (vertical-bart'vertical-bar<0.2 GeV^2) for the dominant waves in the 1200-to-2000-MeV mass range. We observe the 2^+ $K^*(1430)$ and clear signals for the 1^+ $Q_2(1400)$ and the 3^- $K^*(1800)$. We find a new 1^- resonance at about 1500 MeV and have some evidence for another 1^- resonance at 1800 MeV. We also present the results of a partial-wave analysis as a function of t in the 1430-MeV mass region.

29791 **Early strong interaction counter experiments.** Terwilliger, K.M. (University of Michigan, Ann Arbor, Michigan 48109). *AIP Conf. Proc.;* **60**: No. 1, 70-81(Jun 1980). (CONF-7909111—).

From Symposium on the history of the ZGS; Argonne, IL, USA (13 Sep 1979).

The 17 ° beam and some π-p two body scattering experiments run in the beginning years of the ZGS are discussed. (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

29792 (DOE/ER/70004—261) **Theory of elementary particles. Annual report, 1979.** (Oregon Univ., Eugene (USA)). 1 Oct 1979. Contract EY-76-S-06-2230-004. 7p. (RLO—2230-TA4-261). NTIS, PC A02/MF A01.

Activities for 1979 in the following areas are very briefly summarized: dileptonic processes (hadron-hadron collisions, photon-photon collisions, leading log approximation), ladder approximations in QCD, quark models (clustering, the recombination model), weak interaction phenomenology, nonleptonic decays, grand unification, neutrino pairing, polarization phenomena (general theory, polarization studies of the deuteron, lambda polarization), deuteron targets, and electron beams. There are no data. (RWR)

GENERAL

29793 **Gluon final states in Higgs-boson decay.** Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Phys. Rev., D;* **22**: No. 1, 178-183(1 Jul 1980).

We examine the decays of H → 2 gluons, H → qq-barg, and H → ff-bar (f=some fermion) over an extended range of Higgs-boson and t-quark masses. In particular, we show that the branching ratio for H → 2 gluons may be sizable (~ 10%) without requiring the existence of superheavy quarks. We calculate the differential spherocity and thrust distributions as well as the values of <1-T> and <S> for the H → qq-barg decay.

29794 **Ghost gluon bound state and pseudoscalar mixing.** Palmer, W.F.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **22**: No. 1, 223-224(1 Jul 1980).

We comment on some work of Rosenzweig, Schecter, and Trahern who construct an effective Lagrangian for quantum chromodynamics involving a pseudoscalar ghost glueball field. We point out that a successful description of pseudoscalar mixing we wrote down some years ago indeed requires a pseudoscalar ghost.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 29788

29795 (LBL—10924) **Review of D and B meson decays.** Chanowitz, M.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 20p. (CONF-800588—1). NTIS, PC A02/MF A01.

From International symposium on high energy e+e- interactions; Nashville, TN, USA (1 May 1980).

The theoretical picture of K and D decays is reviewed in order to explain why large enhancements are not expected in D decays. This expectation is contrasted with the available data on lifetimes and semileptonic branching ratios, which hint at large enhancements but are still ambiguous. Some of the theoretical ideas proposed to explain the enhancement of D^0, and possibly F^+ nonleptonic decays are discussed. One of these, together with data presented earlier, suggests a way to detect the F^+ and a possible gluonium state in one fell swoop. New data on D → rhoK/πK have implications for models which predict large nonleptonic enhancements from decays into exclusive final states. These are discussed. (GHT)

29796 **Flavor-changing effective neutral-current couplings in the Weinberg-Salam model.** Ma, E.; Pramudita, A. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). DE-AC03-76ER00511. *Phys. Rev., D;* **22**: No. 1, 214-215(1 Jul 1980).

We compute exactly the effective Zds-bar coupling in the Weinberg-Salam model in the limit of vanishing external momenta. The result is of importance if the effect of the t quark, which has presumably a rather large mass, is to be taken into account.

STRONG INTERACTIONS, GENERAL

29797 **Strongly interacting Higgs bosons.** Appelquist, T.; Bernard, C. (J. W. Gibbs Laboratory, Department of Physics, Yale University, New Haven, Connecticut 06520). EY-76-C-02-3075. *Phys. Rev., D;* **22**: No. 1, 200-213(1 Jul 1980).

The sensitivity of present-energy weak interactions to a strongly interacting heavy-Higgs-boson sector is discussed. The gauged nonlinear σ model, which is the limit of the linear model as the Higgs-boson mass goes to infinity, is used to organize and catalogue all possible heavy-Higgs-boson effects. As long as the SU(2)/sub L/ x SU(2)/sub R/ symmetry of the Higgs sector is preserved, these effects are found to be small, of the order of the square of the gauge coupling times logarithms (but not powers) of the Higgs-boson mass divided by the W mass. We work in the context of a simplified model with gauge group SU(2)/sub L/; the extension to SU(2)/sub L/ x U(1) is briefly discussed.

29798 **Ghost-pole subtraction and the σ-exchange NN potential.** Lomon, E.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069. *Phys. Rev., D;* **22**: No. 1, 229-232(1 Jul 1980).

The summing of all pion bubble graphs in the computation of the σ-meson propagator leads to the appearance of ghost poles when $\sigma\pi\pi$ coupling strengths are equivalent to σ-meson decay widths greater than 625.2 MeV. A result satisfying dispersion relations is obtained by the direct subtraction of the ghost pole from the results published previously by this author. The effect is to decrease the sensitivity to the σ-meson width of both the central and spin-orbit nucleon-nucleon potentials. The potentials are small for separations greater than half a pion Compton wavelength and decrease in magnitude with increasing width. Larger widths are more compatible with phenomenological and dispersion-theory potentials.

STRONG INTERACTIONS, BARYON NO.=1

29799 (SLAC-Trans—0190) **Estimate of the quark-gluon coupling constant.** Sakharov, A.D. (AN SSSR, Moscow. Fizicheskij Inst.). May 1980. Translation source information not available . 8p. NTIS, PC A02/MF A01.

A simple estimate is offered for the value of the effective quark-gluon coupling constant, based on an examination of the dependence of the mass difference of hadrons of identical composition on the electric charge.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO STRONG INTERACTIONS

29800 (COO—3071-247) **Homestake mine proton decay experiment.** Deakyne, M.; Lande, K.; Lee, C.K.; Steinberg, R.; Sutton, S. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Apr 1980. Contract AC02-76ER03071. 16p. NTIS, PC A02/MF A01.

The philosophy, design, and operation of the Homestake mine proton decay experiment are described. Preliminary data on the proton lifetime based on 127 effective days of running time are presented.

FIELD THEORY

REFER ALSO TO CITATION(S) 29794, 29797, 29856

29801 (BNL—27981) **Monte Carlo studies of non-Abelian gauge theories.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 19p. (CONF-800674—1). NTIS, PC A02/MF A01.

From 4. workshop on current problems in high energy particle theory; Bad Honnef, F.R. Germany (2 Jun 1980).

After some general remarks on the efficiency of various Monte Carlo algorithms for gauge theories, the calculation of the asymptotic freedom scales of SU(2) and SU(3) gauge theories in the absence of quarks was discussed. There are large numerical factors between these scales when defined in terms of the bare coupling of the lattice theory or when defined in terms of the physical force between external sources.

29802 (BNL—27995) **Confinement and lattice gauge theory.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1980. Contract AC02-76CH00016. 21p. (CONF-800678—1). NTIS, PC A02/MF A01.

From Symposium on topical questions in QCD; Copenhagen, Denmark (9 Jun 1980).

The motivation for formulating gauge theories on a lattice to study non-perturbative phenomena is reviewed, and recent progress supporting the compatibility of asymptotic freedom and quark confinement in the standard SU(3) Yang-Mills theory of the strong interaction is discussed.

29803 (COO—3130-423) **Introduction to grand unification theories.** Kang, K. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1980. Contract AC02-76ER03130. 14p. (CONF-800374—4). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

The Georgi-Glashow model is introduced based on the minimal gauge group SU(5) as a prototype grand unification theory of the electroweak and strong interactions. Simple estimation of $\sin^2\theta$/sub W/ in the symmetry limit and the renormalization corrections at the energy scale of M/sub W/ are given along with other successes of the SU(5) model.

29804 (SLAC-PUB—2484) **1/N.** Coleman, S. (Stanford Linear Accelerator Center, CA (USA)). Mar 1980. Contract AC03-76SF00515. 72p. NTIS, PC A04/MF A01.

There exist families of field theories with symmetry group SO(N) (or SU(N)) that become simpler as N becomes larger. More precisely, the solutions to these theories possess an expansion in powers of 1/N. This expansion is the subject of these lectures. The 1/N expansion can be used to analyze model field theories. The 1/N expansion is developed for phi^4 theory and applied to two two-dimensional models with similar combinatoric structures, the Gross-Neveu model and the CP/sup N-1/ model. These models display (in the leading 1/N approximation) such interesting phenomena as asymptotic freedom, dynamical symmetry breaking, dimensional transmutation, and non-perturbative confinement. It is possible that the 1/N expansion, with N the number of colors, might fruitfully be applied to quantum chromodynamics. Unfortunately, it is not possible to make a decisive test of the approximation, because no one knows how to compute even the first term in the expansion in closed form. However, it is possible to argue that this first term, whatever its detailed form, has many properties that are also shared by the real world, and which are otherwise underived from field theory. These include the saturation of scattering amplitudes by an infinite number of narrow resonances, the essential feature of dual-resonance models. (RWR)

29805 **More on unconfined quarks and gluons.** De Rujula, A.; Giles, R.C.; Jaffe, R.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069. *Phys. Rev., D;* **22**: No. 1, 227-228(1 Jul 1980).

Georgi has recently argued that our model of quasiconfinement may not be realizable in quantum chromodynamics. Though he raises very relevant issues, his arguments fail to resolve the crucial question of the nature of the transition between confining and nonconfining phases.

NUCLEAR PHYSICS

29806 (DOE/ER—0061) **Summaries of FY 1980 research in the nuclear sciences.** (Department of Energy, Washington, DC (USA). Div. of Nuclear Sciences). Jun 1980. 88p. NTIS, PC A05/MF A01.

A compilation and index of the projects funded in fiscal year 1980 by the DOE Division of Nuclear Sciences/Office of Basic Energy Sciences is provided. These summaries constitute the basic document by which the DOE nuclear sciences program can be made known in some technical detail to interested persons. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

29807 (LA-UR—80-1710) **Polarized neutron beam at LAMPF.** Bhatia, T.S.; Glass, G.; Hiebert, J.C. (Texas A and M Univ., College Station (USA); Los Alamos Scientific Lab., NM (USA); Texas Univ., Austin (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—2). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The polarization of neutrons produced from the reaction pd → anti n was measured at a laboratory angle of 20° at an incident proton kinetic energy of 800 MeV. For the highest energy neutron peak at ~ 665 MeV, as well as for the broad pion production peak at ~ 325 MeV, the neutron polarization has been found to be ~ 0.20. The measured polarization for the quasielastic process has been found to be in good agreement with the free np analyzing power measurements. Such a polarized neutron beam, having a broad spectrum of momenta from 800 to 1300 MeV/c has been used at LAMPF for free np spin correlation measurements.

29808 (LA-UR—80-1733) **Analyzing powers of ^{3}He(p vector,p)^{3}He elastic scattering between 30 and 50 MeV.** Birchall, J.; van Oers, W.T.H.; Conzett, H.E.; von Rossen, P.; Larimer, R.M.; Watson, J.; Brown, R.E. (Manitoba Univ., Winnipeg (Canada). Dept. of Physics; California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Kent State Univ., OH (USA). Dept. of Physics; Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800824—5). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

Analyzing power data have been obtained for ^{3}He(p vector,p)^{3}He elastic scattering at seven energies between 30 and 50 MeV at laboratory angles between 20° and 160°. Errors are typically less than 0.01. These results supplement earlier differential and total reaction cross-section and analyzing power data and new data obtained with a polarized ^{3}He target.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 29809

NUCLEAR REACTIONS AND SCATTERING

29809 (DOE/ER/01388—443) **Radiative capture studies of the electromagnetic decays of highly excited states.** Snover, K.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1980. Contract AC06-76ER01388. 11p. (RLO—1388-443; CONF-800540—2). NTIS, PC A02/MF A01.

From International symposium on highly excited states in nuclear reactions; Osaka, Japan (12 May 1980).

Selected examples of interesting E1, M1, and E2 resonance studies in (p,γ) and (α,γ) reactions are discussed. These include a unique determination of E1 amplitudes in the ^{12}C(P,γ$_0$)^{13}N reaction, E2 strength in light nuclei, M1 decays to the ground states and to the excited O$^+$ states of the doubly magic ^{16}O and ^{40}Ca nuclei, second harmonic E1 resonances in (p,γ), and M1 γ-decay of stretched particle-hole states in ^{16}O and ^{28}Si.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

29810 **Emission patterns in central and peripheral relativistic heavy-ion collisions.** Stock, R.; Gutbrod, H.H.; Meyer, W.G.; Poskanzer, A.M.; Sandoval, A.; Gosset, J.; King, C.H.; King, G.; Lukner, C.; Van Sen, N.; Westfall, G.D.; Wolf, K.L. (Lawrence Berkeley Laboratory, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev. Lett.;* **44**: No. 19, 1243-1246(12 May 1980).

Proton emission in relativistic nuclear collisions is examined for events of low and high multiplicity, corresponding to large and small impact parameters. Peripheral reactions exhibit distributions of protons in agreement with spectator-participant decay modes. Central collisions of equal-size nuclei are dominated by the formation and decay of a fireball system. Central collisions of light projectiles with heavy targets exhibit an enhancement in sideward emission which is predicted by recent hydrodynamical calculations.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 29810

NUCLEAR REACTIONS AND SCATTERING

29811 (DOE/ER/01388—441) **Charge distributions for the ^{86}Kr + ^{139}La system at 505, 610, and 710 MeV.** Dyer, P.; Webb, M.P.; Puigh, R.J.; Vandenbosch, R.; Thomas, T.D.; Zisman, M.S. (Washington Univ., Seattle (USA); Michigan State Univ., East Lansing (USA); Oregon State Univ., Corvallis (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract AC06-76ER01388. 45p. (RLO—1388-441). NTIS, PC A03/MF A01.

Nuclear charge distributions for projectile-like and fission-fragment-like reaction products were measured as a function of angle and energy loss at each of the three bombarding energies E/sub L/ = 505, 610, and 710 MeV for the ^{86}Kr + ^{139}La reaction. The charge distributions at most angles and energy losses are dominated by a peak centered close to the Z of the projectile. The variances of the Z distributions of this component exhibit a different dependence on energy loss at each of the three bombarding energies. A nucleon exchange model incorporating the effects of the Fermi motion and Pauli Principle is quite successful in accounting for the rate of energy loss per exchange deduced from the charge distriction data. This result suggests that nucleon exchange is the major mechanism for energy dissipation in these collisions. The data are also analyzed in the framework of a phenomenological model, from which diffusion constants are obtained. For large energy losses a second peak appears in the charge distribution with a most probable Z equal to one-half the sum of the projectile and target Z. This component is attributed to fusion-fission. The magnitude of the fusion-fission cross section at 505 and 610 MeV is larger than TDHF predictions. 12 figures, 2 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

REFER ALSO TO CITATION(S) 29810

NUCLEAR REACTIONS AND SCATTERING

29812 (LBL—10980) **Interactions of 100 MeV/nucleon ^{40}Ar with uranium.** Frankel, K.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01.

Thesis.

Fragments produced in the interactions of 100 MeV/nucleon ^{40}Ar projectiles with a uranium target were measured at energies from 10 to 130 MeV/nucleon at angles from 10 to 170°. Nuclei with charge $5 \leq Z \leq 10$ were observed. The data can roughly be divided into two groups, corresponding to central and pripheral collisions. The central collision data can be fit with a thermal model that uses two recoiling sources. The source velocities are consistent with predictions of the fireball and target explosion models, but the source temperatures inferred from the data are higher than one would expect on the basis of energy and momentum conservation. These results are similar to those obtained in previous studies at beam energies of 400 and 500 MeV/nucleon. The data also follow the pattern of a universal curve of invariant cross section vs momentum. The projectile fragmentation data are also fit by two thermal sources. There are indications that the observed temperatures are higher than one would expect on the basis of other projectile fragmentation studies. The projectile fragmentation data are studied in terms of a simple friction model. Order-of-magnitude estimates show that the data may be consistent with the model, but further development, calculation, and experimentation are necessary to check the validity of the model at this beam energy. A preliminary investigation is made of the possibility that the projectile may pick up one or more target nucleons before it fragments. This process leads to widening of the distributions at large momentum transfers. Much of the spectrum can be described by falling exponentials in energy in the emitting frames. It is concluded that the observed spectrum is due to nonthermal sources as the temperatures derived

from the slopes of the exponentials are greater than those predicted. 26 figures, 6 tables.

NUCLEAR THEORY

REFER ALSO TO CITATION(S) 29810

NUCLEAR MATTER

29813 (DOE/ER/10353—1) **Computational methods for the nuclear and neutron matter problems. Progress report.** Kalos, M.H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1979. Contract AC02-79ER10353. 13p. NTIS, PC A02/MF A01.

A brief report is given of progress on the development of Monte Carlo methods for the treatment of both simplified and realistic models of extensive neutron and nuclear matter and, eventually, of finite nuclei. A wide class of algorithms that may allow the efficient sampling of the integrands required in calculating the energy expectations with useful trial wave functions was devised. (RWR)

29814 (LBL—10883) **Pion condensation and instabilities: current theory and experiment.** Gyulassy, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 66p. (CONF-800709—2). NTIS, PC A04/MF A01.

From Seminar on high-energy nuclear interactions and properties of dense nuclear matter; Hakone, Japan (7 Jul 1980).

Current calculations of pion condensation phenomena in symmetric nuclear matter are reviewed. The RPA and MFA methods are compared. Latest results [LBL-10572] with a relativistic MFA theory constrained by bulk nuclear properties are presented. The differences between equilibrium (condensation) and nonequilibrium (dynamic) instabilities are discussed. Finally, two-proton correlation experiments aimed at looking for critical scattering phenomena and two-pion correlation experiments aimed at looking for pion field coherence are analyzed. 10 figures, 2 tables.

NUCLEAR REACTIONS AND SCATTERING

29815 (CONF-800452—3) **Angular momentum effects in fusion-fission and fusion-evaporation reactions.** Plasil, F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

From International conference on nuclear behavior at high angular momentum; Strassbourg, France (22 Apr 1980).

The study of heavy-ion fusion reactions is complicated by the possible contributions of several mechanisms. The various types of heavy-ion-induced fission are discussed. Then compound-nucleus fission is considered with reference to fission barriers deduced from heavy-ion-induced fission. Next, the problems associated with measured values of evaporation-residue cross sections and the angular momentum dependence of incomplete fusion are examined. Finally, the de-excitation of compound nuclei is again taken up, this time with reference to the greatly enhanced α emission predicted on the basis of the rotating liquid drop model. 24 figures. (RWR)

29816 (HEDL-SA—2134-FP) **Phenomenology of precquilibrium angular distributions.** Kalbach, C.; Mann, F.M. (Triangle Universities Nuclear Lab., Durham, NC (USA); Hanford Engineering Development Lab., Richland, WA (USA)). May 1980. Contract AC14-76FF02170. 21p. (CONF-800551—19). NTIS, PC A02/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The systematics of continuum angular distributions from a wide variety of light ion nuclear reactions have been studied. To first order, the shape of the angular distributions have been found to depend only on the energy of the outgoing particle and on the division of the cross section into multi-step direct and multi-step compound parts. The angular distributions can be described in terms of Legendre polynomials with the reduced polynomial coefficients exhibiting a simple dependence on the outgoing particle energy. Two integer and four continuous parameters with universal values are needed to describe the coefficients for outgoing energies of 2 to 60 MeV in all the reaction types studied. This parameterization combined with a modified Griffin model computer code permits the calculation of double differential cross sections for light ion continuum reactions where no data is available.

NUCLEAR MODELS

29817 (BNL—27985) **Present status of the VMI and related models.** Scharff-Goldhaber, G. (Cornell Univ., Ithaca, NY (USA); Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 21p. (CONF-800213—12). NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

This article traces the evolution of the Variable Moment of Inertia model in its relation to the shell model, the Bohr-Mottelson model and the Interacting Boson Model. The discovery of a new type of spectrum, that of pseudomagic nuclei (isobars of doubly magic nuclei) is reported, and an explanation for their dynamics is suggested. The type of rotational motion underlying the ground state band of an e-e nucleus is shown to depend on whether the minimum number of valence nucleon pairs of one kind (neutrons or protons) is $\leqq 2$ or > 2. In the former case the alpha-dumbbell model holds; in the latter the two-fluid model.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 29831

29818 (HEDL-SA—2072-FP) **Monte Carlo applications at Hanford Engineering Development Laboratory.** Carter, L.L.; Morford, R.J.; Wilcox, A.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 36p. (CONF-800471—5). NTIS, PC A03/MF A01.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

Twenty applications of neutron and photon transport with Monte Carlo have been described to give an overview of the current effort at HEDL. A satisfaction factor was defined which quantitatively assigns an overall return for each calculation relative to the investment in machine time and expenditure of manpower. Low satisfaction factors are frequently encountered in the calculations. Usually this is due to limitations in execution rates of present day computers, but sometimes a low satisfaction factor is due to computer code limitations, calendar time constraints, or inadequacy of the nuclear data base. Present day computer codes have taken some of the burden off of the user. Nevertheless, it is highly desirable for the engineer using the computer code to have an understanding of particle transport including some intuition for the problems being solved, to understand the construction of sources for the random walk, to understand the interpretation of tallies made by the code, and to have a basic understanding of elementary biasing techniques.

29819 (LBL—9962) **Heavy-ion dosimetry.** Schimmerling, W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01.

This lecture deals with some of the more important physical characteristics of relativistic heavy ions and their measurement, with beam delivery and beam monitoring, and with conventional radiation dosimetry as used in the operation of the BEVALAC biomedical facility for high energy heavy ions (Lyman and Howard, 1977; BEVALAC, 1977). Even so, many fundamental aspects of the interaction of relativistic heavy ions with matter, including important atomic physics and radiation chemical considerations, are not discussed beyond the reminder that such additional understanding is required before an adequte perspective of the problem can be attained.

29820 (ORNL/TM—7404) **Acceleration of the inner iteration of the DOT-IV transport code using a new source correction scheme.** Aull, J.E. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 85p. NTIS, PC A05/MF A01.

A detailed description of the steady-state Boltzmann transport equation is given. Then the discrete ordinates method of solving the transport equation is described. The conventional rebalance method, the source correction scheme of rebalance, and a new source correction scheme involving a correction equation with a modified flow term are derived. Difference equations for each version of the source correction scheme are presented. The different versions of the source correction scheme and the conventional rebalance method are compared on several test problems in one- and two-dimensional slab geometry. Results are shown that demonstrate that the new source correction scheme is superior to the conventional rebalance method. It is also seen that the new source correction scheme is compatible when used with a weighted difference formulation in the inner iteration of the transport solution. 6 figures, 9 tables.

29821 **New technique for backscattering analysis.** Keaton, P.W.; Peercy, P.S.; Doyle, B.L. (Sandia Labs., Albuquerque, NM (USA)); Maggiore, C.J. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Instrum. Methods;* **168**: No. 1-3, 187-190(Jan 1980).

From 4. international conference on ion beam analysis; Aarhus, Denmark (25 - 29 Jun 1979).

We suggest a new technique for analyzing Rutherford backscattering spectra. By determining the ratio of the range of a particle of energy E, to that of a particle whose energy is a fraction of E, we convert two basic integral equations into a pair of linear equations that are easy to solve and manipulate. We demonstrate the applica-

bility of this formalism by using it to measure the stopping power of gold for alpha particles with energies 1.2, 2.2, 3.7, 5.2 and 7.1 MeV.

29822 Repair for scattering expansion truncation errors in transport calculations. Emmett, M.B. (Union Carbide Corp., Oak Ridge, TN); Childs, R.L.; Rhoades, W.A. *Trans. Am. Nucl. Soc.;* 33: 719-721(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

SHIELDING CALCULATIONS AND EXPERIMENTS

29823 Solid neutron shield material tests. Allen, G.C. Jr.; Pope, R.B.; Rack H.J. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* 33: 456-457(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29824 Overview of CSEWG shielding benchmark problems. Maerker, R.E. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 661-662(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29825 Computational benchmark for deep penetration in iron. Carter, L.L. (Hanford Engineering Development Lab., Richland, WA); Hendricks, J.S. *Trans. Am. Nucl. Soc.;* 33: 663-664(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29826 Benchmark shielding problems obtained from integral tests of neutron cross sections. Wehring, B.W.; Dorning, J.J.; Hertel, N.E.; Ingersoll, D.T.; Johnson, R.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 666(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 29818, 29820, 29823, 29826

29827 (BNL—27566) Studies of the phase transitions in UAs with neutron scattering. Sinha, S.K.; Lander, G.H.; Shapiro, S.M.; Vogt, O. (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA); Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). 1980. Contract AC02-76CH00016. 9p. (CONF-800417—3). NTIS, PC A02/MF A01.

From European Physicists Society and Swiss National Science Foundation conference; Zurich, Switzerland (9 Apr 1980).

Uranium arsenide is known to order with the type-I antiferromagnetic (AF) structure at ~ 126 K, and exhibit a first-order transition to the type-IA AF structure at T/sub N//2. We have now reexamined these transitions with a single crystal. Above T/sub N/ UAs exhibits critical scattering suggesting a tendency to order with an incommensurate wavevector, but then suddenly orders with the AF-I structure. The analysis of the data shows the need to consider anisotropic exchange interactions of cubic symmetry between U moments.

29828 (BNL-NCS—51152) Evaluation of natural chromium neutron cross sections for ENDF/B-V. Prince, A.; Burrows, T.W. (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract AC02-76CH00016. 92p. (ENDF—286). NTIS, PC A05/MF A01.

This report describes the evaluation of natural chromium for ENDF/B-V. Neutron cross sections and photon production are presented for the energy range 10^{-5} eV to 20 MeV. An extreme effort was made to incorporate all available new experimental data since the previous ENDF/B-IV evaluation. Particular consideration was also given to consistency between calculation and experimental data and are described in detail. Covariance files are given and are based on model code uncertainties along with empirical data.

29829 (COO—2280-39) Boundary and interface function method for one dimensional neutron transport. Antolak, A.J.; Bareiss, E.H. (Northwestern Univ., Evanston, IL (USA)). Nov 1979. Contract AS02-76ER02280. 100p. NTIS, PC A05/MF A01.

A new numerical method, the Boundary and Interface Function (BIF) Method, for solving the one-dimensional neutron transport equation is formulated. The method derives its mathematical foundation from a two-sided Laplace transform in the space variable with a Fourier transform in the angular variable. The mathematical solution requires that the scalar flux at the boundaries and interfaces (the boundary and interface functions) satisfy systems of singular integral equations. The theory shows that a rather simple numerical method for the solution of the transport equation is feasible which uses only edge- and interface function approximations and no interior space points in the main program. This drastically reduces the order of the associated matrix problem as well as improving the computational execution time on the computer. A computer code has been implemented and numerical results are presented and compared with a reference solution and solutions obtained by conventional methods for one and two region problems.

29830 (LA—8353-MS) Status of Monte Carlo at Los Alamos. Thompson, W.L.; Cashwell, E.D.; Godfrey, T.N.K.; Schrandt, R.G.; Deutsch, O.L.; Booth, T.E. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 69p. NTIS, PC A04/MF A01.

Four papers were presented by Group X-6 on April 22, 1980, at the Oak Ridge Radiation Shielding Information Center (RSIC) Seminar-Workshop on Theory and Applications of Monte Carlo Methods. These papers are combined into one report for convenience and because they are related to each other. The first paper (by Thompson and Cashwell) is a general survey about X-6 and MCNP and is an introduction to the other three papers. It can also serve as a resume of X-6. The second paper (by Godfrey) explains some of the details of geometry specification in MCNP. The third paper (by Cashwell and Schrandt) illustrates calculating flux at a point with MCNP; in particular, the once-more-collided flux estimator is demonstrated. Finally, the fourth paper (by Thompson, Deutsch, and Booth) is a tutorial on some variance-reduction techniques. It should be required for a fledging Monte Carlo practitioner.

29831 Applications of contributon Monte Carlo to deep-penetration transport problems. MAck, J.M.; Dudziak, D.J. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 672-675(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29832 Integral testing of some ENDF/B-V cross sections. Estes, G.P.; Hendricks, J.S. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 679-681(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29833 Energy balance of ENDF/B-V. MacFarlane, R.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 681-682(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29834 Efficient evaluation of multigroup transfer coefficients. Hong, K.J.; Shultis, J.K. (Kansas State Univ., Manhattan). *Trans. Am. Nucl. Soc.;* 33: 686-687(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29835 Cross-section adjustment: sensitivity to uncertainties. Wagschal, J.J. (Oak Ridge National Lab., TN); Maerker, R.E.; Broadhead, B.L. *Trans. Am. Nucl. Soc.;* 33: 698-700(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29836 Comparison of experimental radiation transport with calculation. Kazi, A.H. (Aberdeen Proving Ground, MD); Heimbach, C.R.; Schaenzler, L.; Pace, J.V. III; Rainis, A.E. *Trans. Am. Nucl. Soc.;* 33: 706(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29837 Minimizing splitting costs in Monte Carlo particle transport. Juzaitis, R.J.; Booth, T.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 713-714(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29838 Effectiveness of three rebalance method in deep-penetration problems. Rhoades, W.A. (Oak Ridge National Lab., TN); Tomlinson, E.T. *Trans. Am. Nucl. Soc.;* 33: 717-719(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29839 Comparison of two spatial differencing schemes for the slab transport equation. Miller, W.F. Jr.; Larsen, E.W. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 316-317(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29840 Comparison of spatial approximation methods for the S/sub N/ equations in x,y geometry. Larsen, E.W. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 317-318(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29841 Modified transport formulation compatible with anisotropic diffusion theory. Lewis, E.E. (Northwestern Univ., Evanston, IL); Adams, C.H. *Trans. Am. Nucl. Soc.;* 33: 319-320(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29842 Prediction of computing costs in Monte Carlo transport calculations. Booth, T.E.; Cashwell, E.D. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 321-323(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29843 Benchmark testing of anisotropic diffusion coefficients. Gelbard, E.M. (Argonne National Lab., IL); Pego, R.; McCoy, D.R. *Trans. Am. Nucl. Soc.;* 33: 323-324(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29844 Basis functions for multichannel flux synthesis. Adams, C.H. (Argonne National Lab., IL). *Trans. Am. Nucl. Soc.;* 33: 327-328(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29845 Modified finite elements method for the neutron transport equation. Ferguson, J.M. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 328-329(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29846 Cross-directional coarse- and fine-mesh trial functions. Filippone, W.L. (Univ. of Lowell, MA); Hennart, J.P.; Real, E. *Trans. Am. Nucl. Soc.;* 33: 330-332(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

29847 (RHO-SA—153) Surface soil contamination standards for Rockwell Hanford Operations. Boothe, G.F. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1979. Contract AC06-77RL10130. 18p. (CONF-791234—6). NTIS, PC A02/MF A01.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The four basic radiation protection criteria (external radiation, ingestion of radioactivity, concentrations of radioactivity in air, and concentrations of radioactivity in water) can be met for each type of contamination by deriving contamination limits in the manner described below and adopting the most restrictive limit as a standard. Four separate limits for average soil contamination are developed below. These limits are derived from four conditions that may result in human radiation dose: external radiation, ingestion of soil, airborne radioactivity, and radioactivity in water. The most restrictive limit for each radionuclide is taken as the average surface soil contamination standard. The average surface soil contamination standard is then used to develop areal contamination standards and spot contamination standards.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 28595, 28596, 29315, 29855

29848 (LBL—10966) Spontaneous and stimulated Raman studies of vibrational dephasing in condensed phases. Cornelius, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 185p. NTIS, PC A09/MF A01.

Thesis.

Vibrational dephasing in condensed phases is studied from both a theoretical and experimental standpoint. A theory is presented which describes the dynamics of motional or exchange processes in weakly perturbed systems. This general formalism, which has been previously used to describe motional narrowing in magnetic resonance, is applied to vibrational spectroscopy. The model treats the case of a high frequency vibration anharmonically coupled to a low-frequency vibration. Intermolecular exchange of low frequency vibrational quanta results in a temperature dependent broadening and frequency shift of the high frequency vibration. Analysis of experimental data by this model yields both the exchange rates and the anharmonic couplings.

29849 Magnetic resonance in superionic conductors. Richards, P.M. *Top. Curr. Phys.;* 15: 141-174(1979).

Nuclear magnetic resonance can be a powerful tool for studying motions of ions and therefore has had extensive application in the field of superionic conductors. Being concerned here with basic physics, we make the following distinction between superionic (SI) and low-ionic-conductivity materials: in the latter only a small number of independent particles or vacancies hop whereas large numbers are involved in the former. Thus correlated motion is a major aspect of the problem, and it is of interest to see what can be learned about this from nuclear magnetic resonance (NMR). To understand the features of the dynamics which can be delineated and how NMR might be useful in distinguishing correlated from independent particle motion, this technique is considered in conjunction with bulk conductivity and infrared or Raman spectroscopy.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 29299, 29348

29850 (BNL—28001) Studies of the strain-dependent properties of A15 filamentary conductors at Brookhaven National Laboratory. Luhman, T.; Welch, D.O. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 17p. (CONF-800587—3). NTIS, PC A02/MF A01.

From International cryogenic materials conference; Upton, NY, USA (28 May 1980).

Work at BNL pertaining to the strain response of filamentary bronze-processed superconductors is reviewed. This work includes the intrinsic strain dependence of the critical properties of A15 structure compounds, the nature of the initial internal strain state of composite conductors, and the interplay between these residual strains and applied strains which governs the response of the conductor to external strain. Some factors which can enhance the strain tolerances of filamentary conductors are briefly discussed. (GHT)

29851 (CONF-800587—2) Evidence for microstructural effects under strain in bronze process Nb_3Sn. Kroeger, D.M.; Easton, D.S.; Koch, C.C.; DasGupta, A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From International cryogenic materials conference; Upton, NY, USA (28 May 1980).

The possible effects of externally applied strain on the flux pinning process can be divided into two groups according to whether the significant property changes produced by strain are associated with the crystalline defects which act as flux pinners, or with the bulk superconducting material which carries the supercurrent. The question of whether there is a microstructural component to the strain dependence of Fp by carefully determining whether the bulk property changes which occur can adequately account for all of the variation of Fp with strain. Examination of the results in light of current theories of flux pinning and type-II superconductivity indicates that bulk property changes do not account for all of the change in Fp, suggesting that microstructural effects are also important. (GHT)

29852 (DOE/ER/01198—1315) Superconductivity and the structural phase transitions in palladium hydride and palladium deuteride. Standley, R.W. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract AC02-76ER01198. 132p. NTIS, PC A07/MF A01.

Thesis.

The results of two experimental studies of the superconducting transition temperature, T/sub c/, of palladium hydride, PdH/sub x/, and palladium deuteride, PdD/sub x/, are presented. In the first study, the superconducting transition temperature of PdH/sub x/ (D/sub x/) is studied as a function of H(D) concentration, x, in the temperature range from 0.2 K to 4K. The data join smoothly with those reported previously by Miller and Satterthwaite at higher temperatures, and the composite data are described by the empirical relation T/sub c/ = 150.8 (x-x/sub o/)$^{2.344}$, where x/sub o/ = 0.715 for hydride samples and 0.668 for deuteride samples. The results, when compared with the theoretical predictions of Klein and Papaconstantopoulos, et al., raise questions about the validity of their explanation of the reverse isotope effect, which is based solely on a difference in force constants. In the second study, the effect of the order-disorder structural transition associated with the 50 K anomaly on the superconductivity of PdH/sub x/(D/sub x/) is investigated. Samples were quenched to low temperatures in the disordered state, and their transition temperatures measured. The samples were then annealed just below the anomaly temperature, and the ordering

process followed by monitoring the change in sample resistance. The transition temperatures in the ordered state were then measured.

29853 (DOE/ER/01198—1316) **Electron tunneling into superconducting indium and lead films containing the magnetic impurity manganese.** Tsang, J.K. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract AC02-76ER01198. 145p. NTIS, PC A07/MF A01.

Thesis.

Tunneling measurements of quench-condensed In-Mn and Pb-Mn alloy films were made. The results were compared with Shiba's theory of superconductors containing magnetic impurities. The localized excited impurity states predicted by Shiba's theory were observed in both alloys. In addition to s-wave scattering, it was necessary to include p- and d-wave scattering of the conduction electrons in the theory in order to explain the experimental data. Partial agreement between the theory and the experimental data was obtained using phase shifts from band calculations by A.B. Kunz. The results on In-Mn also agree with thermal conductivity data.

29854 (DOE/ER/10436—1) **Far infrared studies of superconducting V_3Si, Nb_3Ge, and Nb. Progress report and renewal proposal.** Perkowitz, S. (Emory Univ., Atlanta, GA (USA). Dept. of Physics). 1980. Contract AS05-79ER10436. 14p. NTIS, PC A02/MF A01.

Far infrared techniques in the range 10 to 200 cm^{-1} (1 to 25 meV) will be used to examine the high temperature superconductors V_3Si, Nb_3Ge, and Nb, and the high-temperature granular superconductor NbN. Fourier and laser spectrometers and the new technique of laser thermal spectroscopy will yield information about the electron-phonon spectral function, the temperature dependence of superconducting properties, and other fundamental aspects of high temperature homogeneous and inhomogeneous superconductors. A detailed theoretical analysis will complement the experimental work. The information gained may help in the basic understanding of high temperature superconductivity and in the development of improved superconducting materials for applications.

29855 **Unified theory of dislocation motion including thermal activation and inertial effects.** Isaac, R.D.; Granato, A.V. (Univ. of Illinois, Urbana). Contract EY-76-C-02-1198. pp 493-498 of Strength of metals and alloys. Haasen, P. (ed.). New York, NY; Pergamon Press (1979).

Transition-state rate theory has generally been used to explain the temperature dependence of the flow stress of a crystal. However, the existence of a change in the flow stress during the superconducting transition indicates the presence of inertial effects in which dislocations overcome obstacles mechanically rather than thermally. It is shown here that the thermally activated and the inertial overcoming of obstacles are not unrelated but can both be derived from principles of stochastic motion. This leads to a theory of dislocation motion that includes both thermal activation and inertial effects. It is also shown that a distribution of activation energies must be considered to account for the experimental data.

THEORETICAL PHYSICS

RELATIVITY AND GRAVITATION

29856 (ORO—3992-280) **Four lectures on Poincare gauge field theory.** Hehl, F.W. (Texas Univ., Austin (USA). Center for Particle Theory). Dec 1979. Contract AS05-76ER03992. 54p. NTIS, PC A04/MF A01.

The Poincare (inhomogeneous Lorentz) group underlies special relativity. In these lectures a consistent formalism is developed to allow an appropriate gauging of the Poincare group. The physical laws are formulated in terms of points, orthonormal tetrad frames, and components of the matter fields with respect to these frames. The laws are postulated to be gauge invariant under local Poincare transformations. This implies the existence of 4 translational gauge potentials e/sup α/ (gravitons) and 6 Lorentz gauge potentials Γ/sup $\alpha\ \beta$/ (rotons) and the coupling of the momentum current and the spin current of matter to these potentials, respectively. In this way one is led to a Riemann-Cartan space-time carrying torsion and curvature, richer in structure than the space-time of general relativity. The Riemann-Cartan space-time is controlled by the two general gauge field equations, in which material momentum and spin act as sources. The general framework of the theory is summarized in a table. Options for picking a gauge field Lagrangian are discussed (teleparallelism, ECSK). A Lagrangian quadratic in torsion and curvature governing the propagation of gravitons and rotons is proposed. A suppression of the rotons leads back to general relativity. 77 references, 3 figures, 1 table.

29857 **Elastic spacetime: black holes and gravitational waves.** Smarr, L.L.; Press, W.H. *Am. Sci.;* 66: No. 1, 72-79(Jan 1978).

The history of gravitation theories is reviewed first. It is noted that Einstein's theory uses the metric tensor as the gravitational field. An attempt is made to visualize the concept of curved space, and then the more subtle notion of curved time is addressed. Time passes at different rates at different places. To provide a time coordinate system, imaginary observers accelerate so as to remain as stationary as possible: space is incompressible. Evolving space-times are described, and the results of computer calculations for several cases including the collision of two black holes are shown. 7 figures. (RWR)

ELECTRICITY AND MAGNETISM

29858 (SAND—80-1235C) **Collinear n-body problem of classical electrodynamics.** Driver, R.D.; Norris, M.J. (Rhode Island Univ., Kingston (USA); Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 17p. (CONF-800634—1). NTIS, PC A02/MF A01.

From International conference on nonlinear phenomena in mathematical sciences; Arlington, TX, USA (16 Jun 1980).

One model for the motion of n charged particles on the x-axis leads to a system of delay differential equations with delays that depend on the unknown trajectories. If appropriate past histories of the trajectories are given, say on [-r,0], then for sufficiently small $t \geq 0$ one has a system of n^2 ordinary differential equations of the form $y' = f(t,y)$ with $y(0) = y_0$ given. The function f, which involves the known past histories of the trajectories, is continuous; thus, existence of solutions is assured. However, f does not satisfy the Lipschitz condition usually used for proving uniqueness. The main new result is that the solution of the above equation is unique provided.

MATHEMATICAL PHYSICS

29859 **Differential sensitivity theory for nonlinear equations with nonlinear responses.** Weber, C.F.; Cacuci, D.G.; Oblow, E.M. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 338-340(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

FUSION ENERGY

PLASMA RESEARCH

REFER ALSO TO CITATION(S) 29029

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 29914

29860 (CONF-791102—170) **Ring power balance optimization in an EBT fusion reactor.** Uckan, N.A.; Borowski, S.K.; Batchelor, D.B.; Hedrick, C.L.; Jaeger, E.F. (Oak Ridge National Lab., TN (USA); Michigan Univ., Ann Arbor (USA)). 1979. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The key element of the ELMO Bumpy Torus (EBT) concept is the presence of the relativistic hot electron rings (annuli) that are formed in each sector of the torus. If the plasma in a reactor is heated to ignition, the toroidal plasma heating will be turned off; the ring heating will, however, have to be sustained throughout the steady-state operation because these hot electron rings are essential for the stable operation of EBT. Therefore, the tradeoff between the quality of confinement afforded by the hot electron rings and the power required to sustain them represents an important consideration in a reactor. A simple power balance scheme for a reactor has been developed to determine the ring power losses on the reactor Q value. The results indicate that the drag cooling dominates the ring power balance for ring energies in the range of 100 to 600 keV. Although a broad minimum exists in the annulus power loss curves for optimization, the results are sensitive to the details of the scaling parameters assumed. Within the extreme cases of the assumptions, the overall system Q is in the range of 8 to 100. Detailed studies are under way to determine the dominant mechanisms that influence the ring performance.

29861 (COO—5125-2) **Investigation of barrier cell and auxilliary heating in a tandem mirror. Annual progress report, October 1, 1979-September 30, 1980.** Kesner, J.; Emmert, G.A.; Howard, J.E. (Wisconsin Univ., Madison (USA)). Jun 1980. Contract AC02-79ET53083. 8p. NTIS, PC A02/MF A01.

A number of areas relating to RF heating and thermal barrier formation in a tandem mirror have been investigated. The possibility of creating axisymmetric confinement through the use of sloshing-

ions has been investigated. We have also suggested the complimentary concept of sloshing-electrons. Self-consistent thermal barrier formation has been studied and ion drift orbits in non-axisymmetric barriers are being investigated. The study of dynamic stabilization of the DCLC by RF fields has been extended to ω near 2 ω/sub ci/; significant stabilization is found. Fast and slow wave heating have been extensively studied using single particle theory. A new theory of relativistic ECH is under development.

29862 Coupling to the fast wave at lower hybrid frequencies. Theilhaber, K.; Berg, A. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* 20: No. 5, 547-555(May 1980).

Launching of the fast wave in the lower hybrid frequency range is described. This wave is excited at the plasma edge by RF electric fields perpendicular to those required for the lower hybrid wave. In high-temperature plasmas, where the lower hybrid wave may not penetrate because of Landau damping or other effects near the edge, the fast wave might provide an alternative for heating and/or current generation in the central portion of the plasma. In addition, for high-density plasmas, this has the advantage that lower frequencies than those required for the lower hybrid excitation can be used. Thus waveguides of convenient dimensions for maximum power transmission and ease of fabrication can be employed. Coupling from a waveguide array into an inhomogeneous plasma is analysed. The model is infinite in y, the direction perpendicular to magnetic field and density gradient. Power reflection in the waveguides is found as a function of array design and density gradient at the edge. This reflection is fairly large (>20%). Propagation into the plasma is then considered, and the field structure and dispersion of the fast waves are found as functions of the distance of penetration. Unlike the lower hybrid waves, fast waves do not form resonance cones and energy is dispersed over a large volume.

29863 Theoretical study of electron-cyclotron absorption in ELMO Bumpy Torus. Batchelor, D.B.; Goldfinger, R.C. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* 20: No. 4, 403-418(Apr 1980).

The basic features of microwave propagation and electron-cyclotron damping in ELMO Bumpy Torus (EBT) devices are investigated to provide an understanding of the heating of the toroidal core plasma component. The characteristics of microwave propagation in EBT geometry, where there is strong variation of abs B vector along field lines, are described and contrast is made with the electron-cyclotron heating (ECH) of tokamaks. Linear cyclotron damping calculations are presented for plasmas having parameters typical of EBT-I and parameters projected for EBT-II. It is shown that the extraordinary mode is completely absorbed near the fundamental cyclotron resonance when propagating from the high-magnetic-field side (mirror throat). For EBT-I parameters, heating by the ordinary mode at the fundamental cyclotron resonance and by both modes at the second-harmonic resonance is negligible. For projected EBT-II parameters, the ordinary mode is heavily damped at the fundamental and the extraordinary mode is heavily damped at the second harmonic. Since the right-hand cut-off prevents injected extraordinary-mode energy from propagating to the cyclotron resonance, a mechanism must exist outside of geometrical optics by which the extraordinary mode reaches resonance. It is argued that this mechanism is the conversion of ordinary-mode energy to extraordinary mode in the high-field region upon wall reflection.

29864 (GA-A—15951) **Shaping and characteristics of ohmically heated noncircular plasmas in Doublet III.** Wesley, J.C.; Angel, T.; Armentrout, C.J. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET51011. 13p. (CONF-800707—15). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Ohmically heated dee, droplet and doublet plasmas with vertical elongations of up to 3.2 have been produced in Doublet III. Doublet configurations are now obtained by controlled merging of the two current channels of a droplet discharge. All discharges have low levels of impurities and central radiated power and achieve high density relative to B/sub T//R scaling. The energy confinement follows the standard circular cross-section Alcator scaling law. The lack of significant improvement in the confinement due to vertical elongation is consistent with the high degree of current peaking inferred from magnetic measurements.

29865 Magnetoacoustic heating by ion Landau damping. Turner, L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). E(11-1)-3070. *Phys. Fluids;* 23: No. 7, 1415-1421(Jul 1980).

There have been recent experimental observations of collisionless damping of Alfven waves and m=0, k=0 magnetoacoustic waves at high beta. In the absence of microinstabilities and for nonzero k, it will be shown that collisionless absorption can provide a heating mechanism when an equilibrium plasma column is pumped by oscillations of the confining magnetic field at a frequency near the oblique (i.e., k not = 0) magnetoacoustic frequency. In particular, the dynamics of a sharp-boundary, Vlasov-fluid screw pinch are studied analytically using the following ordering scheme: σ=r/sub L//r_0, ω/ω/sub c/=O(σ), kr_0=O(1), ω/kv/sub th/ =O(1), local beta=O(1), $r_0$del/sub perpendicular/=O(1). The resulting equations keep ion kinetic effects along magnetic field lines while retaining only ion fluid effects transverse to the field lines. To leading order all finite-Larmor-radius effects are absent. However, Landau damping leads to collisionless absorption of energy by the ions for k not = 0 at an oblique magnetoacoustic resonance. An example of a resonance line profile along with the associated heating time scale and induced rf electric field will be presented.

29866 Surface heating, density rippling, and propagation cones in high-power lower-hybrid heating. Matsuda, K.; Matsuda, Y.; Guest, G.E. (General Atomic Company, San Diego, California 92138). DE-AT03-76ET51011; W-7405-ENG-48. *Phys. Fluids;* 23: No. 7, 1422-1425(Jul 1980).

A two-and-one-half dimensional electrostatic particle simulation code has been applied to study power penetration of the lower-hybrid plasma heating. Strong surface electron heating (stochastic) is observed. Density ripples due to ponderomotive forces along a constant magnetic field appear, not near the plasma surface, but slightly deeper inside the plasma. As an effect of surface heating, the lower-hybrid propagation cones are bent more toward the magnetic field lines, impairing penetration of the lower-hybrid waves.

29867 Staged laser heating of a magnetically confined plasma. Quimby, D.C.; Steinhauer, L.C. (Mathematical Sciences Northwest, Inc., Bellevue, Washington 98009). EY-76-CO-06-2319. *Phys. Fluids;* 23: No. 7, 1426-1435(Jul 1980).

Staged laser heating uses simultaneous laser irradiation and magnetic compression to heat a plasma. An analytic model and one-dimensional magnetohydrodynamic computations are presented in order to characterize plasma conditions achievable by this method. In particular, results relevant to a recent experiment and results relevant to a fusion reactor plasma are described.

29868 Study of quasi-mode parametric excitations in lower-hybrid heating of tokamak plasmas. Villalon, E.; Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* 20: No. 3, 243-259(Mar 1980).

A detailed linear and non-linear analysis of quasi-mode parametric excitations relevant to experiments in supplementary heating of tokamak plasmas is presented. The linear analysis includes the full ion-cyclotron harmonic quasi-mode spectrum. The non-linear analysis, considering depletion of the pump electric field, is applied to the recent Alcator A heating experiment. Because of the very different characteristics of a tokamak plasma near the wall (in the shadow of the limiter) and inside, the quasi-mode excitations are studied independently for the plasma edge and the main bulk of the plasma, and for two typical regimes in overall density, the low (peak in density, $n_0=1.5\times10^{14}cm^{-3}$) and high ($n_0=5\times10^{14}cm^{-3}$) density regimes. At the edge of the plasma and for the low-density regime, it is found that higher nsub(z)(nsub(z)=cksub(z)/ω) than those predicted by the linear theory are strongly excited. Inside the plasma, the excitation of higher wave numbers is also significant. These results indicate that a large amount of the RF-power may not penetrate to the plasma centre, but will rather be either Landau-damped on the electrons or mode-converted into thermal modes, close to the plasma edge. Moreover, for sufficiently high peaks in density, it is found that all the RF-power is mode-converted before reaching the plasma centre. Inside the plasma, the power density of the excited sideband fields is shown to be always very small in comparison with their excitation at the plasma edge.

29869 Neutral-beam injection calculations for torsatrons. Anderson, D.T.; Shohet, J.L. (Wisconsin Univ., Madison (USA)); Rehker, S. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Tataronis, J.A. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). *Nucl. Fusion;* 20: No. 2, 197-202(Feb 1980).

A numerical investigation of the effectiveness of neutral-beam heating in two torsatron-type devices has been undertaken. A modified version of a well-known deposition and orbit code was used for this purpose. It was found that, for beam currents within the applicable range of the model, neutral beams can efficiently heat either a 'classical' torsatron or an 'ultimate' torsatron plasma provided the injection is tangential to the magnetic axis. These results were obtained by following ionized test particles down to thermalization. Efficiency of the injection drops as the angle approaches perpendicular, because of relatively poor containment of helically trapped orbits within the assumed plasma volume.

29870 Simple annulus power balance in EBT experiments. Borowski, S.K.; Kammash, T. (Michigan Univ., Ann Arbor (USA)); Uckan, N.A.; Jaeger, E.F. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* 20: No. 2, 177-188(Feb 1980).

An essential feature of the ELMO Bumpy Torus (EBT) concept is the presence of a relativistic electron annulus in each of

the toroidal mirror sectors. These high-beta annuli are formed and sustained by microwave heating and are of sufficient density and temperature that diamagnetic currents produce the necessary minimum in the magnetic field required for MHD stability of the toroidal core plasma. Since electron rings play an important role in confinement characteristics and performance of EBT, the trade-off between the quality of the confinement afforded by the rings and the power required to sustain them represents an important consideration in a fusion reactor. A power balance for the rings that includes energy transfer between the hot annulus electrons and the core electrons via Coulomb collisions (drag cooling), in addition to radiation (synchrotron and bremsstrahlung) and pitch-angle scattering of the ring electrons, indicates that drag dominates the annulus energy balance in EBT-I. Drag cooling of the relativistic annulus electrons on the toroidal core plasma appears to provide a reasonable explanation for the decrease in the annulus electron temperature in going from ELMO to EBT-I. Theoretical estimates of the microwave power required to sustain the annulus are found to be within a factor of two of the experimentally determined value. Scaling projections for both EBT-I and EBT-S are shown, enabling one to examine the sensitivity of the annulus electron temperature as a function of core plasma density for various microwave power levels. The results indicate that a range of annular beta values between 15-30% are achievable for projected EBT-S toroidal plasma parameters if the microwave power levels are in the range of approximately 10-15 kW. Further extrapolations to future planned experiments are also included along with the sensitivity of these results.

29871 Observation of radio-frequency-driven plasma current in the Octopole tokamak. La Haye, R.J.; Armentrout, C.J.; Harvey, R.W.; Moeller, C.P.; Stambaugh, R.D. (General Atomic Co., San Diego, CA (USA)). *Nucl. Fusion;* **20**: No. 2, 218-222(Feb 1980).

A toroidally unidirectional slow wave is launched at a frequency well above the lower hybrid resonance. The effects of the wave on the toroidal plasma current are presented and compared with predictions of quasi-linear electron Landau damping theory.

29872 Characteristics of lower-hybrid-wave-driven steady-state tokamak power reactors. Yuen, S.Y.; Kaplan, D.; Cohn, D.R. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). *Nucl. Fusion;* **20**: No. 2, 159-169(Feb 1980).

The use of lower hybrid waves for current drive in steady-state tokamak power reactors is studied. Constraints imposed by RF wave propagation are considered. The effect of decoupling of electron and ion temperatures is studied and is found to enhance the ratio of fusion power to dissipated power. Trade-offs for parameters of RF-driven steady-state reactors are determined. It is found that RF-driven steady-state current operation is especially suitable for high-field high-density reactor designs. For example, this study indicates that a tokamak power reactor characterized by a major radius of 6 m, a magnetic field on axis of 7.5 T, and a fusion power output of 2500 MW could be driven in steady-state operation with RF power level equal to 2.5% of the fusion power output.

29873 MFTF physics experiments. Porter, G.D. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **33**: 92-93(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29874 Finite orbit treatment of plasma buildup in small mirrors. Campbell, M.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **33**: 104-106(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 29884

29875 (UCRL-Trans—11592) Investigation of the characteristics of the plasma of the Utro fast linear theta pinch by electron optical spectroscopy. Burtsev, V.A.; Kubasov, V.A.; Lyublin, B.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). [nd]. Translation of Preprint P-K-0438, 1979. 22p. NTIS, PC A02/MF A01.

Experiments aimed at investigating the plasma of a fast theta pinch by electron optical methods are described. Problems of the use of image converters to record radiation in pulsed thermonuclear facilities are treated. The operation of the LV-03 Time Loop instrument under various conditions is described. Results of the measurement of electron concentration, results of the study of discharge dynamics, and preliminary data on end scattering of the plasma are presented. Attention is paid to the methods used to set up the experimets and to the processing of the photographs obtained by means of image converters.

29876 (ORNL/TM—7282) Computer-controlled data acquisition system for the ISX-B neutral injection system. Edmonds, P.H.; Sherrill, B.; Pearce, J.W. (Oak Ridge National Lab., TN (USA)). May 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

A data acquisition system for the Impurity Study Experiment (ISX-B) neutral injection system at the Oak Ridge National Laboratory is presented. The system is based on CAMAC standards and is controlled by a MIK-11/2 microcomputer. The system operates at the ion source high voltage on the source table, transmitting the analyzed data to a terminal at ground potential. This reduces the complexity of the communications link and also allows much flexibility in the diagnostics and eventual control of the beam line.

29877 (PPPL—1669) Forbidden lines of highly ionized ions for localized plasma diagnostics. Hinnov, E.; Fonck, R.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1980. Contract AM02-76CH03073. 20p. (CONF-800320—4). NTIS, PC A02/MF A01.

From 3. topical conference on high temperature plasma diagnostics; Los Angeles, CA, USA (17 Mar 1980).

Numerous optically forbidden lines resulting from magnetic dipole transitions in low-lying electron configurations of highly ionized Fe, Ti and Cr atoms have been identified in PLT and PDX tokamak discharges, and applied for localized diagnostics in the high-temperature (0.5 to 3.0 keV) interior of these plasmas. The measurements include determination of local ion densities and their variation in time, and of ion motions (ion temperature, plasma rotations) through Doppler effect of the lines. These forbidden lines are particularly appropriate for such measurements because under typical tokamak conditions their emissivities are quite high (10^{11} to 10^{14} photons/cm^3-sec), and their relatively long wavelengths allow the use of intricate optical techniques and instrumentation. The spatial location of the emissivity is directly measurable, and tends to occur near radii where the ionization potential of the ion in question is equal to the local electron temperature. In future larger and presumably higher-temperature tokamaks analogous measurements with somewhat heavier atoms, particularly krypton, and perhaps zirconium appear both feasible and desirable.

29878 (UCID—18704) Introduction to magnetic confinement fusion diagnostics. Turner, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jun 1980. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01.

These notes present a brief survey of some of the current diagnostic techniques used in magnetic fusion plasma devices. To give an idea of the range of parameters and geometries encountered the parameters of four representative experiments - PLT, TMX, ZT-40 and EBT-I(S) - are given. The central issue of all experiments is to understand the flow of power which can be summarized by two volume integrated equations for the ions and electrons.

29879 Molybdenum and chlorine x-ray emission from Alcator A. Rice, J.E.; Marmar, E.S.; Coan, T.; Allen, S.L.; Cowan, R.D. (Plasma Fusion Center, Francis Bitter National Magnet Laboratory, M.I.T., Cambridge, Massachusetts 02139). *Phys. Rev., A;* **22**: No. 1, 310-312(Jul 1980).

High-resolution ($\Delta\lambda/\lambda \simeq 0.015$) x-ray spectra in the wavelength region 3.7 → 6.2 A (3.4 → 2.0 keV) have been collected from the Alcator tokamak using a flat crystal Bragg monochromator. Molybdenum L lines and chlorine K lines have been observed and charge-state identifications have been made by comparison with calculations.

29880 Interferometer for the measurement of plasma density. Jacobson, A.R. (to Dept. of Energy). US Patent 4,183,671. 15 Jan 1980. Filed date 14 Mar 1978. 4p.

PAT-APPL-886,377.

An interferometer is described which combines the advantages of a coupled cavity interferometer requiring alignment of only one light beam, and a quadrature interferometer which has the ability to track multi-fringe phase excursions unambiguously. The device utilizes a Bragg cell for generating a signal which is electronically analyzed to unambiguously determine phase modulation which is proportional to the path integral of the plasma density.

PLASMA KINETICS - GENERAL

29881 (GA-A—15899) Optimization and control of the plasma shape and current profile in noncircular cross-section tokamaks. Moore, R.W.; Bernard, L.C.; Chan, V.S.; Davidson, R.H.; Dobrott, D.R.; Helton, F.J.; Miller, R.L.; Pfeiffer, W.; Waltz, R.E.; Wang, T.S. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET51011. 15p. (IAEA-CN—38/J-5; CONF-800707—13). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

High-β equilibria which are stable to all ideal MHD modes are found by optimizing the plasma shape and current profile for doublets, up-down asymmetric dees, and symmetric dees. The ideal MHD stability of these equilibria for low toroidal mode number n is analyzed with a global MHD stability code, GATO. The stability to

high-n modes is analyzed with a localized ballooning code, BLOON. The attainment of high β is facilitated by an automated optimization search on shape and current parameters. The equilibria are calculated with a free-boundary equilibrium code using coils appropriate for the Doublet III experimental device. The optimal equilibria are characterized by broad current profiles with values of β/sub poloidal/ ≃1. Experimental realization of the shapes and current profiles giving the highest β limits is explored with a 1 1/2-D transport code, which simulates the time evolution of the 2-D MHD equilibrium while calculating consistent current profiles from a 1-D transport model. Transport simulations indicate that nearly optimal shapes may be obtained provided that the currents in the field-shaping coils are appropriately programmed and the plasma current profile is sufficiently broad. Obtaining broad current profiles is possible by current ramping, neutral beam heating, and electron cyclotron heating. With combinations of these techniques it is possible to approach the optimum β predicted by the MHD theory.

PLASMA KINETICS - EXPERIMENTAL

29882 (CONF-800455—12) **Arcing studies in ISX-B.** Clausing, R.E.; Emerson, L.C.; Heatherly, L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

Results of experimental measurements of arcing in ISX-B are described. Samples of stainless steel were exposed at the plasma edge and arcing currents to the sample were measured. Currents from several amperes up to 100 amperes were observed. It was possible to trigger arcs during well-behaved discharges by applying a high voltage to the sample. Elemental analysis of surface features of samples has shown that sulfur segregates to surfaces of arc craters in type 304 stainless steel. Detection of sulfur on surface samples may be related to arcing during cleanup processes in tokamaks.

29883 (PPPL—1668) **Impurity control in TFTR.** Cecchi, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1980. Contract AM02-76CH03073. 48p. (CONF-800455—16). NTIS, PC A03/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

The control of impurities in TFTR will be a particularly difficult problem due to the large energy and particle fluxes expected in the device. As part of the TFTR Flexibility Modification (TEM) project, a program has been implemented to address this problem. Transport code simulations are used to infer an impurity limit criterion as a function of the impurity atomic number. The configurational designs of the limiters and associated protective plates are discussed along with the consideration of thermal and mechanical loads due to normal plasma operation, neutral beams, and plasma disruptions. A summary is given of the materials-related research, which has been a collaborative effort involving groups at Argonne National Laboratory, Sandia Laboratories, and Princeton Plasma Physics Laboratory. Conceptual designs are shown for getterng systems capable of regenerating absorbed tritium. Research on this topic by groups at the previously mentioned laboratories and SAES Research Laboratory is reviewed.

29884 **Collisionless flow and end loss from a high-energy theta-pinch plasma.** McKenna, K.F.; Bartsch, R.R.; Commisso, R.J.; Ekdahl, C.; Quinn, W.E.; Siemon, R.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* 23: No. 7, 1443-1463(Jul 1980).

End-loss experiments on the high-energy (T/sub e/+T/sub i/ =3.3 keV, n/sub e/=1.5 x 10^{16} cm^{-3}) 5 m Scylla IV-P theta pinch are reported. The evolution of the theta-pinch plasma parameters in the presence of axial losses and the behavior of the exhausting plasma near the ends of the device have been investigated. The measured decay of the theta-pinch plasma electron temperature agrees with code predictions based on classical axial thermal conduction losses. However, the axial ion heat flux is found to be unmeasurably small in the collisionless ion plasma. Energy-line-density measurements at the coil midplane also agree with code predictions and provide evidence of inward traveling rarefaction-like waves. At the theta-pinch ends, the exhausting plasma is comprised of a collimated plasma core which remains radially confined for tens of centimeters, strongly convects magnetic fields, and contains the bulk of the ejected plasma. This collimated core is surrounded by a plasma annulus that expands rapidly to the walls after leaving the theta-pinch coil. The radially confined exhaust plasma is successfully modeled as one-dimensional flow through a converging-diverging nozzle. The new results obtained in Scylla IV-P have led to a re-analysis of the particle end-loss data obtained in previous experiments. The subsequent comparison of experiments and theory shows that the normalized particle end-loss time is independent of both the plasma beta and collisionality regime.

29885 **Spatial profiles of light impurity ions in the Alcator A tokamak plasma.** Chen, K.I.; Terry, J.L.; Moos, H.W. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics); Marmar, E.S. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). *Nucl. Fusion;* 20: No. 2, 189-195(Feb 1980).

Spatial profiles of the concentrations of the highly ionized light impurities (O V, O VI, N V) have been obtained in the Alcator A tokamak by using an absolutely calibrated 0.4-m normal-incidence ultraviolet monochromator. In the inversion process, account has been taken of the observed up-down asymmetries in the UV emissions from these impurity ions. The concentrations of oxygen and nitrogen at the periphery relative to the local electron density are found to be 0.05-0.1% and 0.08-0.15%, respectively, at the time of the peak electron density. The positions and breadths of these shells have been studied as functions of electron density and plasma current. The shells show sharply defined outer edges near the local virtual limiter radius while the inner edges appear to be determined by the temperature profile.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 29965

29886 (LA-UR—80-1834) **Initial reversed-field pinch experiments on ZT-40 and recent advances in RFP theory.** Baker, D.A.; Buchenauer, C.J.; Burkhardt, L.C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 13p. (CONF-800707—11). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

The ZT-40 reversed-field pinch (RFP) has been operated in several modes: (1) without reversed toroidal field, (2) with self reversal, and (3) with aided reversal. An analytic ohmic heating and ignition model both confirm and provide guidance for transport codes. Nondissipative formation schemes have been analyzed and ideal MHD stable evolution and burn scenarios have been found. Particle and fluid simulations have produced qualitative agreement with respect to the nonlinear behavior of m = 0 resistive g-modes. Helical ohmic reversed field states are produced by a 2-D dynamical simulation, and nonlinear analytic work describes the final state. A fast resistive MHD code for linear stability has clarified the relations between several kinds of resistive instabilities. Ballooning modes and g-modes in systems with arbitrary magnetic shear including resistivity and viscosity, have been studied in a unified treatment with growth rate vs wavenumber showing the existence of important cutoffs.

29887 (ORNL/TM—7424) **HIFI: a computer code for projectile fragmentation accompanied by incomplete fusion.** Wu, J.R. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 55p. NTIS, PC A04/MF A01.

A brief summary of a model proposed to describe projectile fragmentation accompanied by incomplete fusion and the instructions for the use of the computer code HIFI are given. The code HIFI calculates single inclusive spectra, coincident spectra and excitation functions resulting from particle-induced reactions. It is a multipurpose program which can calculate any type of coincident spectra as long as the reaction is assumed to take place in two steps.

29888 **Iterative approach to strong turbulence theory.** Knorr, G.; Mond, M. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). EY-76-S-02-2059. *Phys. Fluids;* 23: No. 7, 1301-1305(Jul 1980).

Starting from the equations for turbulence, relations are derived which allow the computation of the correlation function of turbulent modes. This is achieved by using the following ideas: (1) The turbulence equations are interpreted as stochastic equations. (2) The directness of interaction of the different modes is ordered according to the number of modes necessary to establish the feedback of a given mode on itself. (3) A non-Markovian dynamical friction is introduced and is determined by the condition that the average stochastic force should be zero. In lowest order, Kraichnan's direct interaction approximation is recovered.

29889 **Higher corrections to the direct interaction approximation in turbulence theory.** Mond, M.; Knorr, G. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). EY-76-S-02-2059. *Phys. Fluids;* 23: No. 7, 1306-1310(Jul 1980).

The next higher approximation to the direct interaction approximation is calculated making use of an approach to the turbulent equations which has been reported earlier. The equations of turbulence are interpreted as stochastic equations and an ordering scheme is set up which depends on increasingly indirect feedback of a mode on itself. In the lowest approximation, the direct interaction approximation is recovered. A calculation of the next higher approximation

beyond the direct interaction approximation is presented. The higher approximations are of increasing order and are a formal expansion in "powers" of Green's functions which appear in convolution integrals.

29890 Cross-field electron transport due to thermal electromagnetic fluctuations. Lin, A.T.; Dawson, J.M.; Okuda, H. (Department of Physics, University of California, Los Angeles, California 90024). EY-76-C-03-0010, TASK III. *Phys. Fluids;* 23: No. 7, 1316-1318(Jul 1980).

The cross-field electron particle and energy transport for a high β thermal plasma is investigated using a magnetostatic particle code. The diffusion process due to magnetic fluctutations alone is observed to have a Bohm-like scaling. However, when both electrostatic convective cells and magnetic fluctuations are allowed, there is interference between the two diffusive processes; the diffusion takes on the character of strong turbulence for the interaction between these static modes. The resulting diffusion is smaller than would be the case when assuming that these modes are independent.

29891 Particle orbits in ion rings: Ergodic or not?. Larrabee, D.A.; Lovelace, R.V. (Department of Applied Physics, Cornell University, Ithaca, New York 14853). EY-76-S-02-2319, A00L. *Phys. Fluids;* 23: No. 7, 1436-1442(Jul 1980).

An analytic and numerical study has been made of the single-particle orbits in self-consistent, large gyroradii ion ring Vlasov equilibria. In most of the cases studied the numerically computed orbits are nonergodic, indicating the existence of a constant of the motion, K, in addition to the Hamiltonian, H, and the canonical angular momentum, P/sub theta/. An analytic method for understanding the occurrence of nonergodic orbits is obtained from an analysis of the orbital stability of the class of particles which have orbits lying near the midplane of the ring. Finally, a discussion is given of an illustrative case of a distribution function f dependent on three constants of the single-particle motion, H, P/sub theta/, and K. In this case there may be a toroidal self-magnetic field in contrast with conventional equilibria.

29892 High-energy runaway orbits in the presence of an m=2 magnetic island. Zweben, S.J.; Waddell, B.V.; Swain, D.W. (Oak Ridge National Lab., TN (USA)); Fleischmann, H.H. (Cornell Univ., Ithaca, NY (USA)). *Nucl. Fusion;* 20: No. 4, 477-482(Apr 1980).

A guiding-centre computer code is used to map out trajectories of collisionless high-energy runaways in the presence of an m=2 magnetic island in a tokamak. The particle drift surfaces retain the island structure even when the drift orbits are considerably shifted from the flux surfaces, and trapped-particle orbits are observed to be unaffected by the presence of the island.

29893 Numerical simulation of the anomalous transport process in radially compressed reversed-field configurations. Hamasaki, S. (Science Applications, Inc., La Jolla, CA (USA)); Book, D.L. (Naval Research Lab., Washington, DC (USA)). *Nucl. Fusion;* 20: No. 3, 289-304(Mar 1980).

A one-dimensional quasi-equilibrium MHD code has been used to study the effect of heat transport in belt-pinch-like reversed-field configurations compressed by an imploding cylindrical conducting liner. The code incorporates classical and anomalous transport coefficients, including drift ion cyclotron and lower hybrid instabilities with fluctuation amplitudes limited by shear and finite-beta stabilization. For a reactor-size imploding-liner configuration, heat conduction produces flat-topped temperature profiles and peaked densities. Scaling the reactor size down by a factor of five leads to a considerable increase of anomalous heat losses. A high-field, low-density buffer region near the wall is effective as a heat insulator, provided the field is sufficiently sheared there.

29894 Effect of a weak vertical magnetic field on fluctuation-induced transport in a Bumpy-Torus plasma. Kim, Y.C.; Powers, E.J.; Hong, J.Y. (Texas Univ., Austin (USA). Electronics Research Center); Roth, J.R.; Krawczonek, W.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). *Nucl. Fusion;* 20: No. 2, 171-176(Feb 1980).

Digital spectral analysis techniques are used to observe that, under the appropriate experimental conditions, the radial fluctuation-induced transport in the NASA Lewis Bumpy Torus plasma may be reversed from outward to inward by applying a weak vertical magnetic field. This reversal in the transport direction corresponds to a reversal in the sign of the phase angle between the density and potential fluctuations and results in an enhancement of the plasma density by a factor of five or more.

29895 Shape control of Doublets. Miller, R.L. (General Atomic Co., San Diego, CA (USA)). *Nucl. Fusion;* 20: No. 2, 133-147(Feb 1980).

A 1-1/2-D tokamak transport code is used to model the evolution of doublet geometry on the transport time scale. The doublet shape is determined by the plasma current profile and the current flowing in the field-shaping coils. The current profile is determined in turn by the assumed transport mechanisms for the densities and temperatures and by any auxiliary heating which may be present. In a large hot machine, such as Doublet III, the time-dependent current profile will also depend upon the assumed initial profile because the skin time is long. As the plasma current evolves, the field-shaping coils must be actively programmed to preserve a desired shape. Using an idealized transport model and a DIII-size plasma, the effects of these key elements upon shape evolution are illustrated, and control of doublet equilibria on a transport time scale is demonstrated for this model. The components of the current profile (p' and ff') obtained should serve as a guide to selecting realistic profiles for MHD stability studies.

29896 Energetic charged-fusion-product slowing in inertial confinement fusion plasmas. Choi, C.K.; Sutton, W.R.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 34-35(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29897 Studies of fusion product energy distributions in field-reversed mirrors. Driemeyer, D.; Ohnishi, M.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 35-36(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29898 Model for the angular rotation in FRTP. Fang, Q.T.; Miley, G.H. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 36-38(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29899 Plasma simulation of the ELMO Bumpy Torus Reactor (EBTR). Krakowski, R.A.; Hagenson, R.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 38-40(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29900 Thermal consequences to the tokamak first wall during a disruption for spatial nonuniform energy deposition. Becraft, W.R. (General Electric Co., Oak Ridge, TN); Onega, R.J.; Kukielka, C. *Trans. Am. Nucl. Soc.;* 33: 40(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29901 Physics of burn control in tokamak reactors. Attenberger, S.E.; Houlberg, W.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 40-42(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29902 Cyclotron radiation transport in plasmas by neutron transport techniques. Blue, T.E.; Gilligan, J.G.; Miley, G.H.; Tetley, W.C. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* 33: 42-43(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

PLASMA INSTABILITIES

29903 (UCID—18720) Use of a simple quadrupole magnet model for MHD stability calculations in a tandem mirror reactor. Myall, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jun 1980. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01.

Results are given of calculations in which an attempt was made to increase the MHD-stability-limited ratio of central cell to end plug beta, β/sub c/β/sub p/, in a tandem mirror reactor with quadrupole type end plugs. Both Interchange and Ballooning stability were considered, the latter in all cases being the more severe limit. The investigation was split into two main parts. In the first the axially symmetric fields were kept constant, while the quadrupole fields were adjusted. In the second this process was revered.

29904 Linear analysis of the double-tearing mode. Pritchett, P.L.; Lee, Y.C.; Drake, J.F. (Department of Physics, University of California, Los Angeles, California 90024). DE-AMO3-76SF00010 PA 26/TASK III; DE-AC05-7918-53044. *Phys. Fluids;* 23: No. 7, 1368-1374(Jul 1980).

The linear behavior of the double-tearing mode is investigated within the framework of magnetohydrodynamics. A two-space-scale analysis in which resistive solutions valid near the rational surfaces are joined to ideal solutions outside these regions is performed and used to derive the dispersion relation for the mode. If the separation of the rational surfaces at x= +- x/sub s/ is sufficiently small [x/sub s//a<(k/sub y/a)/sup -7/9/S/sup -1/9/], the growth rate is predicted to scale as S/sup -1/3/, and the structure of the mode proves to be essentially identical with that of the m=1 tearing mode in

cylindrical geometry. With increasing separation, the mode makes a transition to the S/sup -3/5/ scaling and structure of the standard tearing mode. These predictions are confirmed by direct numerical solution of the magnetohydrodynamic equations, and the S⁻/sup 1/3/ scaling is shown to be correlated with violations of the constant-psi approximation. Possible physical implications of the double-tearing mode are discussed.

29905 Magnetic driving energy of the collisional tearing modes. Adler, E.A.; Kulsrud, R.M.; White, R.B. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 7, 1375-1379(Jul 1980).

The change in the magnetic energy density produced by a collisional tearing mode is calculated exactly. The driving energy for the mode is found to come entirely from the region inside the tearing layer, although there is also a displacement of energy in the outer region which integrates to zero. The total change in magnetic energy is exactly equal to the change in a quadratic form related to a variational principle for the full resistive equations.

29906 Stability effects of an external conducting open sheet on magnetically confined plasmas. Weston, V.H. (Purdue University, West Lafayette, Indiana 47907). EY-76-S-02-4125. *Phys. Fluids;* **23**: No. 7, 1388-1395(Jul 1980).

The effect of different outer conducting configurations on the stability of a cylindrical plasma is treated with emphasis on the k∼0, n=1 mode corresponding to perturbation of the form exp(ikz +- inθ). The conducting configuration is comprised of an open segment of a cylinder with a gap in it. The problem is formulated in terms of a singular-differential integral equation which is then reduced to a regular Fredholm integral equation which can be solved numerically. Results are given for a circular segment (-α<θ<α, r=A) for various values of the half-angle α and radius A, both in the presence of and absence of a complete circular outer conductor. The stability effects of the various geometries are compared through their resulting value for the minimum vacuum energy integral.

29907 Stability of drift-wave eigenmodes with arbitrary radial wavelengths. Lee, Y.C. (California Univ., Los Angeles (USA). Dept. of Physics); Chen, L.; Nevins, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **20**: No. 4, 482-485(Apr 1980).

A general theory for the stability of collisionless drift-wave eigenmodes in sheared slab magnetic fields is developed using the S-matrix technique. The eigenmodes are described with the integral formulation which fully takes into account the non-local effects of finite ion gyro-orbits. The universal eigenmode is then shown to be absoultely stable for arbitrary radial wavelengths.

29908 Applicability of high-n ballooning theory. Charlton, L.A.; Nelson, D.B.; Dory, R.A. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* **20**: No. 3, 339-341(Mar 1980).

An axisymmetric tokamak equilibrium has been found for which the 1/n correction term to ballooning theory is as large as the $(1/n)^0$ term. It is concluded that improvements to the theory are needed to assess stability of such an equilibrium.

29909 Drift-mode stability analysis for the Tandem Mirror. Horton, W. (Texas Univ., Austin (USA). Dept. of Physics). *Nucl. Fusion;* **20**: No. 3, 321-337(Mar 1980).

Drift-mode stability analysis for the Tandem Mirror Experiment is formulated assuming MHD-stability from magnetic field curvature and plasma rotation. The self-consistent field equations describe two potentially unstable drift modes. For ksub(parallel) approximately 2π/Lsub(c), where Lsub(c) is the length of the central cell, the electron drift wave occurs with ω approximately ω*sub(e)S(b, etasub(i)) approximately ksub(parallel)vsub(A) with a radial localization to the region of maximum electron diamagnetic drift frequency ω*sub(e). For flute-like axial modes, the ion drift wave ω approximately ω*sub(i)>ksub(parallel)vsub(A) occurs. The ion drift mode is less radially localized and extends to high frequencies for large ksub(perpendicular)rhosub(i). Stability conditions as a function of etasub(i), etasub(e), β and Tsub(i)/Tsub(e) are developed for the drift modes including the guiding-centre drifts and bounce frequency resonances with the electrons.

29910 Analytic and numerical studies of microinstabilities driven by ions. Ogden, J.M. College Park, MD; Univ. of Maryland (1977). 193p. University Microfilms Order No. 78-05,030.

Thesis (Ph. D.).

Three microstability problems are studied analytically and numerically. This work applies to a wide variety of astrophysical and laboratory plasmas in which the ion dynamics are important. In the first part of this thesis, we have examined the linear and nonlinear stages of an electromagnetic ion cyclotron or ion whistler instability, which is driven by ion energy anisotropy, T/sub i/vertical bar > T/sub i/double vertical bar, in a magnetized plasma. The instability is characterized by a broad band of transverse, electromagnetic modes, propagating along the magnetic field. Secondly, we examine the microstability properties of a theta-pinch with reflected ions. Finally, the microstability properties of field-reversing ion layers were investigated.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 29862, 29865

29911 (PPPL—1670) Externally launched ion Berstein wave in the ACT-1 toroidal device. Ono, M.; Wong, K.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1980. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01.

In a hydrogen plasma (T/sub e/ = 2.5 eV, T/sub i/ = 1.5 eV), excitation of ion Bernstein waves by an externally placed electrostatic antenna has been investigated for ω ≃ 2 Ω/sub i/. Mode transformation of the electron plasma wave at ω ≃ ω/sub pi/ without observable reflection was observed, followed by strong excitation of the ion Bernstein wave. Detailed measurements of k/sub perpendicular to/(ω,k/sub parallel/) and of the wave packet trajectory show excellent agreement with theory.

29912 Studies of sidescatter and backscatter from pre-ionized plasmas. Herbst, M.J.; Clayton, C.E.; Peebles, W.A.; Chen, F.F. (University of California, Los Angeles, California 90024). EY-76-S-03-0034. *Phys. Fluids;* **23**: No. 7, 1319-1325(Jul 1980).

Stimulated Brillouin scattering at 180° and sidescatter at 90° are observed when CO_2 laser light is incident on an arc-pre-ionized, underdense plasma target. Scattering occurs in short spikes, sometimes early in the pulse, sometimes delayed by as much as 700 nsec. This time behavior depends critically on the state of pre-ionization and is explained by the evolution of a laser-driven ionization wave. Using ruby laser interferometry, it is possible to infer the sources of backscatter and sidescatter within this disturbance. In addition, by using a smooth input pulse, it is found that the spikiness of Brillouin scatter is not due solely to mode beating in the input beam.

29913 Raman backscatter in high temperature, inhomogeneous plasmas. Kruer, W.L.; Estabrook, K.; Lasinski, B.F.; Langdon, A.B. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Fluids;* **23**: No. 7, 1326-1329(Jul 1980).

The behavior of Raman backscatter of intense laser light in a high temperature, inhomogeneous plasma is examined in theory and simulations. Plasma conditions thought to be characteristic of recent long pulse length experiments are considered. Significant levels of reflected light are found near $\omega_0/2$, a frequency which is not commonly monitored in experiments. It is shown that the plasma temperature leads to a sizable shift of the spectrum to frequencies below $\omega_0/2$. Conditions for significant Raman backscatter at densities much less than one-fourth the critical density are also briefly considered.

29914 Brillouin and Raman scattering of an extraordinary mode in a magnetized plasma. Grebogi, C.; Liu, C.S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **23**: No. 7, 1330-1335(Jul 1980).

The effects of magnetic field on the stimulated Brillouin and Raman scattering processes are studied. The formalism applies to plasmas produced by CO_2 lasers and to electron cyclotron heating of toroidal systems by an extraordinary electromagnetic wave. In the case of laser fusion the plasma is magnetized due to the self-generated dc magnetic field, while in toroidal plasmas it is due to the external magnetic field. The magnetic field greatly reduces the threshold for Brillouin backscattering by the lower hybrid wave. The Raman scattering by the upper hybrid wave has substantial growth rate even for large kλ/sub D/ because of the reduction of linear Landau damping due to the magnetic field.

29915 Eikonal expansion of the Vlasov—Maxwell equations valid near cyclotron resonance. Weitzner, H.; Batchelor, D.B. (New York University, New York, New York 10012). W-7405-ENG-26;EY-76-C-02-3077. *Phys. Fluids;* **23**: No. 7, 1359-1367(Jul 1980).

In the usual formulations of geometrical optics, the physics of the medium enters the equations through a conductivity tensor operator σ. An essential assumption in the subsequent expansion is that the magnitude of σ/sup H/, the Hermitian part of σ, is much smaller than σ/sup A/, the anti-Hermitian part. In a finite temperature plasma with ω/sub p/e∼vertical-barΩ/sub e/vertical-bar, this condition is always violated sufficiently close to cyclotron resonance, even though in many cases the waves are weakly damped and k is slowly varying. Simultaneously expanding the Vlasov equation and Maxwell equations and taking explicit account of the relative magnitude of the electric field components in the ordering scheme yields a formalism in terms of real rays, real eikonal functions, and slowly varying amplitude that is valid at cyclotron resonance. It is assumed that ω/sub p/e∼vertical-barΩ/sub e/vertical-bar∼ω are large, that ω≃vertical-barΩ/sub e/vertical-bar, and that v/sub e/k/ω is small. It is shown that when the waves are weakly damped at cyclotron resonance, the ray trajectories are, to leading order,

exactly those of cold plasma theory. A Poynting theorem that can be put into the standard form is obtained by taking the expansion to first order. Care must be taken, however, to include finite temperature effects in calculating the zero-order electric field. The theory is also applied to ion cyclotron resonance.

29916 Effect of waveguide boundary conditions on the backscatter of lower hybrid waves. Schuss, J.J. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). *Nucl. Fusion;* 20: No. 4, 465-475(Apr 1980).

The effect of waveguide boundary conditions on the ksub(parallel) spectrum resulting from the backscatter of lower hybrid waves near a waveguide array is calculated. It is found that the resulting ksub(parallel) spectrum is peaked at multiples of π/b, where b is the waveguide width. This calculation may partially explain recent lower hybrid heating results on Alcator A.

29917 Self-consistent density profiles for obliquely incident light. Montry, G.R.; Powers, L.V.; Berger, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). *Nucl. Fusion;* 20: No. 3, 283-287(Mar 1980).

Self-consistent solutions to the plasma density and flow profile are obtained to the steady-state, isothermal hydrodynamic equations including the ponderomotive force for obliquely incident light when the upstream flow velocity is supersonic. The coupled set of hydrodynamic equations and the wave equation is solved numerically using an iterative procedure that adjusts the initial guess until a self-consistent solution is found. The fraction of light absorbed resonantly and the sensitivity of this fraction to plasma parameters are obtained.

29918 Active-passive waveguide array for wave excitation in plasmas. Motley, R.W.; Hooke, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* 20: No. 2, 222-224(Feb 1980).

A modified version of the standard waveguide grill for exciting lower hybrid plasma waves is proposed. This version, consisting of alternate active and passive elements, permits a number of important engineering simplifications and also reduces the amplitude of the (undesirable) surface component of the wavenumber spectrum. Results from a simple two-element array excited at low power are presented.

29919 Collective radio-emission from plasmas. Papadopoulos, K.; Freund, H.P. (Maryland Univ., College Park (USA)). *Space Sci. Rev.;* 24: No. 4, 511-566(Dec 1979).

Collective radiation processes operating in laboratory and space plasmas are reviewed with an emphasis towards astrophysical applications. Particular stress is placed on the physics involved in the various processes rather than in the detailed derivation of the formulas. Radiation processes from stable non-thermal, weakly turbulent and strongly turbulent magnetized and unmagnetized plasmas are discussed. The general theoretical ideas involved in amplification processes such as stimulated scattering are presented along with their application to free electron and plasma lasers. Direct radio-emission of electromagnetic waves by linear instabilities driven by beams or velocity anisotropies are shown to be of relevance in space applications. Finally, as an example of the computational state of the art pertaining to plasma radiation, a study of the type III solar radio bursts is presented.

29920 Ion acoustic solitons in a plasma: a review of their experimental properties and related theories. Tran, M.Q. (California Univ., Los Angeles (USA). Dept. of Physics). *Phys. Scr.;* 20: No. 3-4, 317-327(Sep-Oct 1979).

A review of experiments and theories on ion acoustic solitons is presented. Taking into account quadratic nonlinearity in the fluid equation leads to the Korteweg-de Vries (KdV) equation which predicts the existence of solitons. Experimental confirmation of their existence came with the availability of plasma with large Tsub(e)/Tsub(i) which allows one to minimize damping. However, the experimental data on the dependency of Mach number vs. solution amplitude clearly shows a discrepancy with the prediction of the KdV equation. The recent theories do include the effects of finite ion temperature and those due to the trapped electron population. The inclusion of nonlinearity of order higher than quadratic leads to the notion of dressed solitons the dynamic behaviour of which has been studied numerically. A discussion of other nonlinear equations describing ion acoustic waves will also be presented.

29921 Variational calculation of electron response in plasma waves and impurity transport in the collisional regime with large poloidal electrostatic variation. Chang, C.S. Austin, TX; Univ. of Texas (1979). 78p. University Microfilms Order No. 79-20,096.

Thesis (Ph. D.).

A variational theory is used to calculate the electron's linear response to electromagnetic perturbations in the presence of the general collision frequency, temperature gradient, and density gradient. Instead of Krook model, Lorentz model is used for collision operator, thus including angle scattering for all velocity space. The possibility of large electrostatic variation near the edge region of a toroidal plasma column is studied by using the fluid equations, assuming all plasma species to be collision dominated. It is found that either of two plausible orderings can lead to a poloidal electrostatic variation, which is comparable with variation of magnetic field. The new neoclassical transport coefficients are calculated for this ase.

FUSION POWER PLANT TECHNOLOGY

29922 (LA-UR—80-1826) Compact torus experiments and theory. Armstrong, W.T.; Barnes, D.C.; Bartsch, R.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 32p. (CONF-800707—12). NTIS, PC A03/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Two types of compact toroids have been studied: spheromaks and field-reversed configurations (FRC). Spheromaks, which contain both toroidal and poloidal fields, have been formed with a magnetized coaxial injector and trapped in both prolate and oblate flux conservers. As expected from theory, the prolate configuration always tilts, but the oblate configuration can be made stable even in the presence of a guide field. Observations include 150μs lifetimes, $\langle n \rangle \sim 10^{14}\,cm^{-3}$, and a decrease of field fluctuations by a factor of 100 at the time of complete reconnection. Theoretical studies of the FRC (no toroidal field) have been compared with the results of two field-reversed theta-pinches, FRX-A and FRX-B.

29923 (LA-UR—80-1828) LASL fast liner experiment. Sherwood, A.R.; Cantrell, E.L.; Henins, I.; Hoida, H.W.; Jarboe, T.R.; Malone, R.C.; Marshall, J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-800707—10). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

The LASL Fast Liner Experiment explores a fusion concept in which a prepared plasma is adiabatically compressed to thermonuclear temperatures and densities by a rapidly imploding solid metal liner. A prepared plasma having $\beta > 1$ is in contact with the liner and end plugs, and contains an embedded magnetic field to inhibit thermal conduction. Cylindrical liners are magnetically imploded by a large axial current carried in the liner shell. Theoretical estimates indicate an implosion velocity of at least 10^6 cm/s is necessary for this geometry if the plasma heating rate is to be greater than the cross-field thermal conduction loss rate. Experimental work to develop this concept involves attempts to provide a suitable preplasma for liner implosions as well as studies of magnetically driven liner implosions. In the plasma preparation experiments a coaxial plasma gun was used to inject plasma into a simulated liner geometry.

29924 Objectives of the Tokamak Magnetic Fusion Program. Jernigan, T.C. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 25-26(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29925 ISX objectives and physics. Mihalczo, J.T. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 26-27(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29926 ISX experiment: facilities and future. Edmonds, P.H. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 27-28(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29927 ISX-B Impurity Study Program. Langley, R.A. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* 33: 28-29(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29928 Tandem mirror fusion-fission system studies. Lee, J.D. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 60-62(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29929 Mirror fusion test facility design and construction. Karpenko, V.N. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 83-85(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29930 Future plans: MFTF-B. Karpenko, V.N. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 85-87(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29931 Fusion with magnetic mirror configurations. Thomassen, K.I. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 87-88(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29932 TMX tandem mirror experiments. Simonen, T.C. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 88-90(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29933 TMX design and construction. Chargin, A.K. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 90-92(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29934 Utility evaluation criteria for application in starfire commercial tokamak design. Carosella, L.A.; DeFreece, D.A.; Waganer, L.M. (McDonnell Douglas Corp., St. Louis, MO). *Trans. Am. Nucl. Soc.;* 33: 94-95(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29935 New central cell design for the tandem mirror reactor. Neef, W.S. Jr. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* 33: 95-96(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29936 Reversed-field pinch reactor. Hagenson, R.L.; Krakowski, R.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 96-98(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29937 TORMAC fusion reactor design points. Miller, R.L.; Krakowski, R.A.; Bathke, C.G. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 98-99(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29938 Evaluation of a committed site for fusion reactor development. Nagy, A. (Bechtel National, Inc., San Francisco, CA); Reid, R.L. *Trans. Am. Nucl. Soc.;* 33: 100-101(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

BLANKET ENGINEERING

29939 (BNL—27958) **Blanket options for high-efficiency fusion power.** Usher, J.L.; Lazareth, O.W.; Fillo, J.A.; Horn, F.L.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 6p. (CONF-800806—25). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

The efficiencies of blankets for fusion reactors are usually in the range of 30 to 40%, limited by the operating temperatures (500°C) of conventional structural materials such as stainless steels. In this project two-zone blankets are proposed; these blankets consist of a low-temperature shell surrounding a high-temperature interior zone. A survey of nucleonics and thermal hydraulic parameters has led to a reference blanket design consisting of a water-cooled stainless steel shell around a BeO, ZrO_2 interior (cooled by argon) utilizing Li_2O for tritium breeding. In this design, approximately 60% of the fusion energy is deposited in the high-temperature interior. The maximum argon temperature is 2230°C leading to an overall efficiency estimate of 55 to 60% for this reference case.

29940 Nuclear performance sensitivities of a TMHR beryllium/molten-salt blanket. Stewart, S.L.; Hartman, A.K.; Harless, W.H. (General Electric Co., Sunnyvale, CA). *Trans. Am. Nucl. Soc.;* 33: 59-60(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29941 Gas-cooled blanket for the tandem mirror hybrid reactor. Schultz, K.R.; Cheng, E.T.; Creedon, R.L.; Wong, C.P.C.; Pierce, V.H.; Seth, S. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* 33: 62-63(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29942 TFTR blanket module experiments. Jassby, D.L. (Princeton Univ., NJ); Caldwell, C.S.; Lewis, R.H.; Pettus, W.G.; Leinoff, S. *Trans. Am. Nucl. Soc.;* 33: 63-65(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29943 Mechanical design of TFTR experimental blanket modules. Womack, R.E.; Caldwell, C.S.; Thornton, T.A. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.;* 33: 65-68(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29944 Neutronics of TFTR breeding modules. Welfare, F.G.; Pettus, W.G. (Babcock and Wilcox Co., Lynchburg, VA). *Trans. Am. Nucl. Soc.;* 33: 68-70(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29945 Tritium transport in a packed-bed Li_2O fusion blanket. Bathke, C.G.; Krakowski, R.A.; Cullingford, H.S. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 72-73(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29946 Thermal and structural analyses of a helium-cooled blanket design for a tokamak reactor. Lee, A.Y.; Prevenslik, T.V. (Fusion Power Systems Dept., Pittsburgh, PA). *Trans. Am. Nucl. Soc.;* 33: 73-74(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29947 Tritium self-sufficient 1600°K process heat fusion reactor blanket concept. Peterson, D.R.; Pendergrass, J.H.; Cort, G.E.; Krakowski, R.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 74-76(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29948 Direct-cycle steam generating blanket design. Cort, G.E.; Hagenson, R.L.; Krakowski, R.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 76-77(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29949 Nucleonic performance aspects of thorium fusion-fission hybrid blanket designs. Cheng, E.T. (General Atomic Co., San Diego, CA). *Trans. Am. Nucl. Soc.;* 33: 724-725(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29950 Fusion/fission hybrid reactor reaction rate sensitivity to changes in fission spectrum. Ostrow, S.L. (Ebasco Services, Inc., New York, NY); Goldstein, H. *Trans. Am. Nucl. Soc.;* 33: 722-723(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

MAGNET COILS AND FIELDS

29951 (GA-A—15924) **Ripple burn control.** Bhadra, D.K.; Petrie, T.W.; Peuron, U.A.; Rawls, J.M. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76ET51011. 29p. (CONF-800685—1). NTIS, PC A03/MF A01.

From INTOR meeting; Vienna, Austria (16 Jun 1980).

The ripple contribution to the ion thermal conductivity is ideally suited in magnitude, temperature dependence, and spatial dependence to serve as a burn control mechanism. Furthermore, a considerable measure of automatic burn control results because of the radial shift of the plasma to a region of higher ripple. Unfortunately, the window in ripple values consistent with both ignition and a burn equilibrium is uncomfortably narrow, given the current lack of contact between the theoretical models of ripple transport and experimental observations. A survey is made of the techniques to vary the ripple and thus broaden the design window. One new technique is discussed in some detail: the use of ferromagnetic materials in the shield with magnetic properties which are sensitive functions of the operating temperature.

29952 (PPPL—1638R) **Generalization of Connor and Hastie's ripple-trapping coefficient, G(α).** Goldston, R.J.; Towner, H.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract AC02-76CH03073. 9p. NTIS, PC A02/MF A01.

In their calculation of transport due to ripple trapping, Connor and Hastie employ a factor G(α) to take into account the poloidal variation of the depth and shape of the local magnetic wells. They assume, however, that the toroidal-field ripple strength, δ, is independent of the poloidal angle. This letter generalizes G to treat

any arbitrary poloidal variation of δ, and also high-beta, non-circular plasma configurations of arbitrary aspect ratio.

29953 (PPPL—1665) **Internal tilting mode stability of non-spherical spheromak.** Yamazaki, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1980. Contract AC02-76CH03073. 12p. NTIS, PC A02/MF A01.

Fixed boundary tilting mode stability is analyzed for spheromak with arbitrarily shaped cross section. A prolate spheromak can be stabilized against tilting mode by adding a conducting shell of triangular or trapesoidal half-cross section.

29954 (UCRL—83518(Rev.1)) **Theory of field-reversed mirrors and field-reversed plasma-gun experiments. Paper IAEA-CN-38/R-2.** Anderson, D.V.; Auerbach, S.P.; Berk, H.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering; California Univ., Berkeley (USA). Lawrence Berkeley Lab.; New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 6 Jun 1980. Contract W-7405-ENG-48. 17p. (CONF-800707—6(Rev.1)). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Experimental and theoretical studies of field reversal in a mirror machine are reported. Plasma-gun experiments demonstrate that reversed-field plasma layers are formed. Low energy plasma flowing behind the initially produced plasma front prevents tearing of the layer from the gun muzzle. MHD simulation shows that tearing can be obtained by impeding the slow plasma flow with a plasma divider. It is demonstrated theoretically that a field-reversed mirror imbedded in a multipole field can be sustained in steady state with neutral-beam injection even in the absence of impurities. MHD stability analysis shows that growth rates of elongated reversed-field θ-pinch configurations decrease with axial extension, which indicates the importance of including finite Larmor radius in the analysis. Tilting-mode criteria are improved by proper shaping, and a problimak shape is proposed. Tearing mode stability of reversed-field θ-pinches is greatly enhanced by flux exclusion. Self-consistent, 1-1/2-dimensional transport codes have been developed, and initial results are presented.

29955 (UCRL—84450) **Studies of the formation of field reversed plasma by a magnetized co-axial plasma gun.** Turner, W.C.; Granneman, E.H.A.; Hartman, C.W.; Prono, D.S.; Taska, J.; Smith, A.C. Jr. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Pacific Gas and Electric Co., San Francisco, CA (USA)). 28 May 1980. Contract W-7405-ENG-48. 7p. (CONF-800484—1). NTIS, PC A02/MF A01.

From Reversed field pinch theory workshop; Los Alamos, NM, USA (28 Apr 1980).

The gun injects axially into a drift tank followed by a magnetic mirror. For the experiments reported here, only the guide coils outside the vacuum vessel and solenoids on the plasma gun electrodes were used; the mirror coil was not energized. A stainless steel flux conserver is placed in the mirror throat to prevent the plasma from contacting the nonconducting vacuum wall in the region of the mirror. An axis encircling array of magnetic loop probes includes four diamagnetic loops and a loop which measures the azimuthally averaged outward pointing radial component of magnetic field. These loop probes are stainless steel jacketed and form a flux conserving boundary (at a radius = 30 cm) for plasma emitted from the gun. A five tip probe that can be positioned anywhere along the axis of the experiment is used to measure internal components of magnetic field.

29956 **Thermally actuated wedge block.** Queen, C.C. Jr. (to Dept. of Energy). US Patent 4,184,665. 22 Jan 1980. Filed date 8 Dec 1978. 4p.

PAT-APPL-967,665.

This invention relates to an automatically-operating wedge block for maintaining intimate structural contact over wide temperature ranges, including cryogenic use. The wedging action depends on the relative thermal expansion of two materials having very different coefficients of thermal expansion. The wedge block expands in thickness when cooled to cryogenic temperatures and contracts in thickness when returned to room temperature.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 29946

HEATING AND FUELING SYSTEMS

29957 (BNL—26895) **Electrode cooling for long pulse high current ion sources.** McKenzie-Wilson, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 5p. (CONF-791102—172). NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The need for cooling of electrode surface in ion sources for neutral beam line applications is summarized. The properties of possible cooling fluids are discussed and the decision to use water as a cooling fluid of choice is explained. The influence of source geometry on the design of a cooling canal is examined and two possible designs are presented. The need for model testing and the results of the tests on a model cathode are also discussed. Some remarks are also made on a method of predicting burnout failure of a cooled electrode.

29958 (COO—2387-120) **Tokamak startup with electron cyclotron heating.** Holly, D.J.; Prager, S.C.; Shepard, D.A.; Sprott, J.C. (Wisconsin Univ., Madison (USA)). Apr 1980. Contract AS02-76ET53051. 14p. NTIS, PC A02/MF A01.

Experiments are described in which the startup voltage in a tokamak is reduced by ~ 60% by the use of a modest amount of electron cyclotron resonance heating power for preionization. A 50% reduction in volt-second requirement and impurity reflux are also observed.

29959 (UCRL—83696) **New concept for a high-power beam dump.** Moir, R.W.; Taylor, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Apr 1980. Contract W-7405-ENG-48. 7p. (CONF-800818—1). NTIS, PC A02/MF A01.

From National heat transfer conference; Orlando, FL, USA (Aug 1980).

A new concept for a dump for the ion and neutral beams used in the controlled nuclear fusion program uses thin sheets of a refractory metal such as tungsten formed into troughs having semicircular cross sections. High-velocity water flowing circumferentially removes heat by subcooled nucleate boiling. Possible advantages are modular construction, lower water-pumping power, and a lower pressure drop than in conventional beam dumps. An example design calculation is shown for a dump capable of absorbing an incident flux of 10 kW/cm^2.

29960 **Plasma physics of intense neutral-beam heating in tokamaks. Report on the IAEA Technical Committee Meeting and Workshop Oak Ridge, Tennessee, United States of America, 25 April - 2 May 1979.** Callen, J.D.; Rome, J.A. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* **20**: No. 4, 501-505(Apr 1980).

The emphasis of the meeting was on comparing the areas of agreement and disagreement among the presently operating high-power injection experiments. The major experimental results presented at the meeting are summarized in this paper (i.e., DITE (Culham), T-11 (Kurchatov), JIPP-I-II (Nagoya), ISX-B (ORNL), PLT (PPPL)). Questions on equilibrium, stability and discharge quality, together with the study of the impurity effects and their diagnostics as well as presentation of the future beam systems are outlined.

29961 **Burn control resulting from toroidal field ripple.** Petrie, T.W.; Rawls, J.M. (General Atomic Co., San Diego, CA (USA)). *Nucl. Fusion;* **20**: No. 4, 419-428(Apr 1980).

The enhanced transport due to toroidal magnetic field ripple is proposed as a means of averting thermal runaway in a tokamak reactor in the post-ignition stage. A theoretical analysis applied to a typical reactor design reveals that peak-to-average edge ripple of the order of 2% is sufficient to terminate the thermal excursion at reasonable values of β without significantly increasing the difficulty of reaching ignition. These analytic predictions, which are shown to agree well with radial transport code results, suggest that a properly specified ripple is one way of achieving a controlled burn in tokamak reactors.

29962 **Ignition of an overheated, underdense, fusioning tokamak plasma.** Singer, C.E.; Jassby, D.L.; Hovey, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **20**: No. 4, 489-497(Apr 1980).

Methods of igniting an 'overheated' but 'underdense' D-T plasma core with a cold plasma blanket are investigated by using a simple two-zone model with a variety of transport scaling laws, and also using a one-dimensional transport code. The power consumption of neutral-beam injectors required to produce ignition can be reduced if the underdense core plasma is heated to temperatures much higher than the final equilibrium ignition values, followed by fuelling from a cold plasma blanket. The reduction in power consumption varies from a modest saving if energy confinement improves rapidly with increasing density in the reactor regime, to a significant saving if energy confinement improves slowly with increasing density. It is also found that the allowed impurity concentration in the initial hot core can be higher than normally permitted for ignition provided that the blanket is free from impurities.

29963 **Magnetic-field distortion near an ablating hydrogen pellet.** Parks, P.B. (General Atomic Co., San Diego, CA (USA)). *Nucl. Fusion;* **20**: No. 3, 311-320(Mar 1980).

A model is formulated to describe the distortion of the magnetic-field near an ablating solid hydrogen pellet in a plasma.

The resistive, collision-dominated ablation cloud expands across the magnetic field. The originally straight magnetic field lines threading the pellet and the ablatant convect outward with the flow and at the same time diffuse inward, giving rise to a rarefaction of the field lines near the pellet. This effect reduces the incident electron energy flux to the ablatant. The resulting modest increase in pellet life-time implies a more favourable outlook for refuelling tokamak reactors by pellet injection.

29964 **Active burn control of nearly ignited plasmas.** Bromberg, L.; Fisher, J.L.; Cohn, D.R. (Massachusetts Inst. of Tech., Plasma Fusion Center, Cambridge, USA). *Nucl. Fusion;* **20**: No. 2, 203-207(Feb 1980).

The stabilization of thermal runaway in nearly ignited plasmas by actively controlled auxiliary heating is considered. The use of a variable amount of auxiliary heating for burn control can greatly increase the values of the power multiplication factor Q (fusion power/auxiliary heating power) relative to those values permitted with constant auxiliary heating. A one-dimensional calculation is used to determine the maximum allowable deviation from thermal equilibrium as a function of the equilibrium temperature and Q. The results are applied to tokamak plasmas. The effect of the auxiliary heating deposition profile upon Q is determined. For fixed deviation from thermal equilibrium, significantly higher values of Q can be obtained with central ion heating relative to those obtained with edge ion heating. Central electron heating has about the same order of effectiveness as edge ion heating. For central temperatures of approximately 25 keV, Q approximately 25 can be obtained if the deviation in the ion temperature is held below 15%.

29965 **Monte Carlo simulation of neutral particle transport in a neutral-beam injector.** Lillie, R.A.; Alsmiller, R.G. Jr.; Gabriel, T.A.; Santoro, R.T.; Schwenterly, S.W. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 43-44(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29966 **^{239}Pu direct enrichment of LWR assemblies in a fusion hybrid.** Kantrowitz, F.; Conn, R.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.;* **33**: 56-57(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29967 **Trade-offs between fuel and power production in fusion-fission hybrids.** Abdel-Khalik, S.I.; Moses, G.A.; Henderson, D.L. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.;* **33**: 57-58(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29968 **P-^{6}Li propagating fusion fuel cycle.** Shuy, G.W.; Conn, R.W. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.;* **33**: 101-102(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29969 **D-T and D-D cycles for fusion-powered ^{233}U factories.** Reneir, J.P. (Oak Ridge National Lab., TN); Martin, J.G. *Trans. Am. Nucl. Soc.;* **33**: 102-104(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29970 **Adjoint technique in microexplosion reactor neutronics.** Reupke, W.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 723-724(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

29971 (CONF-800427—14) **Tritium in fusion reactor components.** Watson, J.S.; Fisher, P.W.; Talbot, J.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic applications; Dayton, OH, USA (29 Apr 1980).

When tritium is used in a fusion energy experiment or reactor, several implications affect and usually restrict the design and operation of the system and involve questions of containment, inventory, and radiation damage. Containment is expected to be particularly important both for high-temperature components and for those components that are prone to require frequent maintenance. Inventory is currently of major significance in cases where safety and environmental considerations limit the experiments to very low levels of tritium. Fewer inventory restrictions are expected as fusion experiments are placed in more-remote locations and as the fusion community gains experience with the use of tritium. However, the advent of power-producing experiments with high-duty cycle will again lead to serious difficulties based principally on tritium availability; cyclic operations with significant regeneration times are the principal problems.

29972 (UCRL—84545) **Modern tools to evaluate and optimize fire protection systems.** Alvares, N.J.; Hasegawa, H.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jun 1980. Contract W-7405-ENG-48. 25p. (CONF-800669—1). NTIS, PC A02/MF A01.

From American Society of Safety Engineers conference; Houston, TX, USA (23 Jun 1980).

Modern techniques, such as fault tree analysis, can be used to obtain engineering descriptions of specific fire protection systems. The analysis allows establishment of an optimum level of fire protection, and evaluates the level of protection provided by various systems. A prime example: the application to fusion energy experiments.

29973 **Liquid lithium behavior and control.** Jeppson, D.W. (Hanford Engineering Development Lab., Richland, WA). *Trans. Am. Nucl. Soc.;* **33**: 259-260(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

POWER CONVERSION SYSTEMS

29974 (BNL—27814) **First wall thermal hydraulic models for fusion blankets.** Fillo, J.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-800723—20). NTIS, PC A02/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

Subject to normal and off-normal reactor conditions, thermal hydraulic models of first walls, e.g., a thermal mass barrier, a tubular shield, and a radiating liner are reviewed. Under normal operation the plasma behaves as expected in a predicted way for transient and steady-state conditions. The most severe thermal loading on the first wall occurs when the plasma becomes unstable and dumps its energy on the wall in a very short period of time (milliseconds). Depending on the plasma dump time and area over which the energy is deposited may result in melting of the first wall surface, and if the temperature is high enough, vaporization.

29975 **Conceptual design of elecrical power module for the TFTR.** Jassby, D.L. (Princeton Univ., NJ); Bullis, R.; Sedgeley, D.; Caldwell, C.S.; Pettus, W.G.; Schluderberg, D.C. *Trans. Am. Nucl. Soc.;* **33**: 70-71(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 29440, 29468, 29471, 29896, 29912, 30013

29976 (DOE/DP/40039—1) **Systems assessment of heavy ion beam fusion drivers. Final report, January 1, 1978-December 31, 1979.** Kammash, T.; Drum, C.R.; Theisen, R.D. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). May 1980. Contract AC08-79DP40039. 44p. NTIS, PC A03/MF A01.

A systems analysis for a fusion reactor utilizing a heavy ion beam-pellet fusion is carried out to evaluate the performance of several potential drivers. These include the two proposed by the Argonne National Laboratory, namely Hearthfire Reference Concepts 2 and 3; the RF linear accelerator proposed by the Brookhaven National Laboratory; and the Induction Linac System advanced by the Lawrence Berkeley Laboratory. It is shown that accelerator systems utilizing rapid cycling synchrotrons are the least attractive drivers unless the efficiency of this component is sufficiently improved. Using a power cost-formula that accounts for the accelerator operating cost it appears on the basis of available data that only one driver might fall within the economically acceptable range of producing electric power at 4 cents a kilowatt hour but only if certain optimistic conditions are met.

29977 (KMSF-U—953) **Interaction of short wavelength laser radiation with spherical shell targets.** Slater, D.C.; Berger, R.L.; Busch, G.E. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 20p. (CONF-800707—14; IAEA-CN—38/I-3). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

Laser plasma interaction experiments have been performed at both 1.05 μm and 0.53 μm. Measurements of absorption and x-ray production from spherical shell targets have shown significant differences between the two laser wavelengths. The laser power on target up to 0.7-TW at 0.53 μm was sufficient to observe effects from a high-temperature corona and confirmed the earlier predictions for wavelength scaling of the hot-electron temperature.

29978 (KMSF-U—967) **Timings of interrupt response and directive execution on a RSX11M V3.2 system.** Barron, M.H.; Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 3p. (CONF-800414—5). NTIS, PC A02/MF A01.

From DECUS spring symposium; Chicago, IL, USA (22 Apr 1980).

Designing application programs for a real time environment requires some idea of how the overall system will perform. One important consideration in designing an application is how long it takes the system to respond to an interrupt or to process an executive directive. In an attempt to gain insight into some of these times, an existing data collection system running RSX11M V3.2 was used for timing executive directives and interrupt response. Timing marks were created under program control by toggeling bits in a DR11-K output register and measuring the output pulses with an oscilloscope. The results of these tests will be discussed as well as their implication to real time data collection.

29979 (M—114(Ref.Manual)) **Shiva Oscillator Alignment System. Reference manual.** Parker, J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 27 May 1980. Contract W-7405-ENG-48. 104p. NTIS, PC A06/MF A01.

Shiva is a 20-arm Nd:glass laser used for inertial confinement fusion experiments. The broad range of control, data acquisition, and analysis functions required to support the system has resulted in the implementation of a hierarchal computer network in which these functions have been divided into major subsystems: power conditioning, fusion target diagnostics, beam disgnostics, and alignment control. The alignment control subsystem includes pointing, centering, and focusing, as well as certain selection operations involving many hundreds of control points from the oscillators to the target. Alignment is accomplished with a chopped CW YAG laser directed from the oscillator through all 20 laser chains to a surrogate target. Sensors placed at strategic locations detect errors and provide feedback through the control system to motor driven gimbals.

29980 (NRL-MR—4237) **NRL research in support of the DOE charged-particle inertial-confinement-fusion program for FY 1977-1978. Final report.** Mosher, D.; Cooperstein, G.; Goldstein, S.A.; Bacon, D.P.; Colombant, D.G.; Johnson, D.J.; Lee, R.; Oliphant, W.F.; Ottinger, P.F.; Sandel, F. (Naval Research Lab., Washington, DC (USA); JAYCOR, Alexandria, VA (USA); Sandia Labs., Albuquerque, NM (USA)). 27 Jun 1980. 68p. NTIS, PC A04/MF A01.

This report and publications referenced within document the NRL effort in support of the DOE charged-particle ICF program for the FY 1977-1978. Research in the areas of new charged-particle beam diodes and transport is reviewed.

29981 (SAND—80-0038) **Finite material temperature model for ion energy deposition in ion-driven ICF targets.** Mehlhorn, T.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC-04-76DP00789. 49p. NTIS, PC A03/MF A01.

A model for use in ion-driven ICF target design has been developed to describe the deposition of energy by an arbitrary ion traversing a material of arbitrary composition, density, and temperature. Particular emphasis has been placed on the deposition physics of light ions having specific energies of 3 MeV/amu or less. However, the model is also applicable to heavy ion fusion problems where specific energies in excess of 10 MeV/amu are found. It has been found that an accurate description of the cold material stopping power must include both shell corrections to the Bethe theory as well as the alternative LSS model at low energies. Finite temperature effects are incorporated by scaling the relevant bound electron parameters with the degree of material ionization as well as by including the free electron stopping power. The phenomena of both range shortening and range relengthening in heated material is discussed. Preliminary calculations indicate that the minimum ion range in heated material is approximately one-half that in cold dense targets independent of the identities of the projectile ion and the host material.

29982 (SAND—80-0461C) **Preliminary PBFA II design.** Johnson, D.L.; VanDevender, J.P.; Martin, T.H. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 6p. (CONF-800640—1). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

The upgrade of Sandia National Laboratories particle beam fusion accelerator, PBFA I, to PBFA II presents several interesting and challenging pulsed power design problems. PBFA II requires increasing the PBFA I output parameters from 2 MV, 30 TW, 1 MJ to 4 MV, 100 TW, 3.5 MJ with the constraint of using much of the same PBFA I hardware. The increased PBFA II output will be obtained by doubling the number of modules (from 36 to 72), increasing the primary energy storage (from 4 MJ to 15 MJ), lowering the pulse forming line (PFL) output impedance, and adding a voltage doubling network.

29983 (SAND—80-0550C) **Pulsed power accelerators for particle beam fusion.** Martin, T.H.; Barr, G.W.; VanDevender, J.P.; White, R.A.; Johnson, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 5p. (CONF-800640—12). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

Sandia National Laboratories is completing the construction phase of the Particle Beam Fusion Accelerator-I (PBFA-I). Testing of the 36 module, 30 TW, 1 MJ output accelerator is in the initial stages. The 4 MJ, PBFA Marx generator has provided 3.6 MA into water-copper sulfate load resistors with a spread from first to last Marx firing between 15 to 25 ns and an output power of 5.7 TW. This accelerator is a modular, lower voltage, pulsed power device that is capable of scaling to power levels exceeding 100 TW. The elements of the PBFA technology and their integration into an accelerator system for particle beam fusion will be discussed.

29984 (SAND—80-0809) **Particle beam fusion program. Publications and related reports: a bibliography, January 1971-July 1979.** Yonas, G. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1980. Contract AC04-76DP00789. 49p. NTIS, PC A03/MF A01.

This bibliography documents the evolution of this program and consolidates its 207 entries into a handy source book. The entries represent documents published by Sandia between January 1, 1971 and July 31, 1979. In order to assist the reader, the reports have been categorized into the general topics of Reviews, Beams and Plasmas, Deposition Physics and Targets, Pulsed Power Technology, and Reactors and Repetitive Pulsed Technology, and arranged in chronological order, with the most recent report in each area presented first. The reports are also cross-indexed by author and by publication number (SLA, SAND, etc.).

29985 (UCID—18644) **Some comments on the Shiva spaceframe earthquake damage.** Hurley, C.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 2 Jun 1980. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01.

On January 24, 1980, at 11:00 a.m., an earthquake, measuring 5.5 on the Richter scale, shook the Livermore Valley. There were three very pronounced shocks, the first at 5.5 followed by two, one at 5.2 and the other at 4.8, on the Richter scale. The Shiva spaceframe was shaken out of alignment. Shiva consists of two frames, a laser frame and a target frame. Components on each frame stayed within alignment with respect to each other, but the target frame moved with respect to the laser frame. Shearing of the seismic anchor bolts on the target frame was responsible for this misalignment. This was the third in a series of earthquakes for Shiva, the first occurring on June 20, 1977 at a magnitude of 4.7 on the Richter scale and an epicenter 2 miles away. The second quake was on August 6, 1979, with a magnitude of 5.9 and the epicenter 60 miles away. There was no damage or misalignment due to these first two earthquakes. The third however, severely tested the Shiva system and will be the subject of this report. Accelerometers were not in operation on the system so we do not know what the acceleration forces were. Our subsequent investigation, however, gives us some indication of these forces.

29986 (UCID—18707) **Laser fusion experiments at LLL.** Ahlstrom, H.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jun 1980. Contract W-7405-ENG-48. 225p. NTIS, PC A10/MF A01.

These notes present the experimental basis and status for laser fusion as developed at LLL. Two other chapters, one authored by K.A. Brueckner and the other by C. Max, present the theoretical implosion physics and laser plasma interaction physics. The notes consist of six sections. The first is an introductory section which provides some of the history of inertial fusion and a simple explanation of the concepts involved. The second section presents an extensive discussion of diagnostic instrumentation used in the LLL Laser Fusion Program. The third section is a presentation of laser facilities and capabilities at LLL. The purpose here is to define capability, not to derive how it was obtained. The fourth and fifth sections present the experimental data on laser-plasma interaction and implosion physics. The last chapter is a short projection of the future.

29987 (UCID—18716) **Simple spherical ablative-implosion model.** Mayer, F.J.; Steele, J.T.; Larsen, J.T. (KMS Fusion, Inc., Ann Arbor, MI (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jun 1980. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

A simple model of the ablative implosion of a high-aspect-ratio (shell radius to shell thickness ratio) spherical shell is described. The model is similar in spirit to Rosenbluth's snowplow model. The scaling of the implosion time was determined in terms of the ablation pressure and the shell parameters such as diameter, wall thickness, and shell density, and compared these to complete hydrodynamic code calculations. The energy transfer efficiency from ablation pres-

sure to shell implosion kinetic energy was examined and found to be very efficient. It may be possible to attach a simple heat-transport calculation to our implosion model to describe the laser-driven ablation-implosion process. The model may be useful for determining other energy driven (e.g., ion beam) implosion scaling.

29988 (UCRL—83204) **Nova: a high energy laser system.** Godwin, R.O. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 12 Oct 1979. Contract W-7405-ENG-48. 8p. (CONF-800140—1). NTIS, PC A02/MF A01.

From Electro Optics conference; Tokyo, Japan (23 Jan 1980).

This review briefly describes the laser system, spatial filter, computer control system, and the 46 cm disk amplifier. (MOW)

29989 (UCRL—83981) **Electrostatic levitation and transport of laser fusion targets.** Johnson, W.L.; Hendricks, C.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 22 May 1980. Contract W-7405-ENG-48. 6p. (CONF-800914—2). NTIS, PC A02/MF A01.

From IEEE meeting; Cincinnati, OH, USA (29 Sep 1980).

Several levitation concepts have been evaluated resulting in the electrostatic quadrupole being chosen as the most universal. A levitator has been constructed to handle laser fusion targets during and between the processing steps. The levitator is based on a quadrupole rail which is segmented to provide electrically controlled transport and confinement along the rail. This device has demonstrated transport both vertical and horizontal of targets with appropriate mass to size ratios and exhibits remarkably stable confinement at atmospheric pressure.

29990 Measurement of core (pR) and compression in inertial confinement fusion targets by activation technique. Hammerling, P. (California Univ., San Diego, La Jolla (USA)). *Phys. Lett., A;* **75**: No. 1/2, 63-64(Dec 1979).

The density in the fuel of an inertial confinement fusion pellet may be measured by neutron activation of krypton or, preferably, xenon admixtures.

29991 Status of inertial fusion technology in the USA. Stickley, M. (Department of Energy, Washington, DC (USA)). *VGB Kraftwerkstech.;* **59**: No. 12, 922-929(Dec 1979). (In German).

The status of inertial fusion technology in the USA is reported. The development goals, the research work to be done, the state of the art of plant components, and the state of development expected by the mid-Eighties are discussed. (orig.) 891 GG/orig. 892 HIS.

29992 NOVA facility and future programs. Simmons, W.W.; Gilmartin, T.J.; Godwin, R.O. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **33**: 30(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29993 HELIOS and the LASL ICF experimental program. Gillespie, C.M.; Godwin, R.P.; Ladish, J.S. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 30-31(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29994 ANTARES and advanced CO_2 laser-fusion systems. Stratton, T.F.; Durham, F.P.; Fenstermacher, C.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 31(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29995 Objectives and current status of the Sandia particle beam fusion program. Kuswa, G.W. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 31(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29996 PBFA facilities and future programs. Barr, G.W. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc.;* **33**: 31-32(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29997 Modeling the neutronics of inertial confinement fusion pellets. Swift, G.M. (Univ. of Illinois, Urbana); Dolatshahi, F.; Southworth, F.H.; Wehring, B.W. *Trans. Am. Nucl. Soc.;* **33**: 33-34(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29998 Pool-type ICF reactor driven by a heavy ion beam. Monsler, M.J. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **33**: 45-46(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

29999 Response of cavity gases to particle beam target explosions. Peterson, R.R.; Moses, G.A. (Univ. of Wisconsin, Madison). *Trans. Am. Nucl. Soc.;* **33**: 46-47(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30000 Modeling of phenomena in magnetically protected ICF reactor cavities. Bohachevsky, I.O.; Dickman, D.O.; Devaney, J.J.; Goldstein, J.C.; Larson, A.R.; Pendergrass, J.H. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 47-48(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30001 Plant layouts for carbon dioxide laser-driven fusion power plants. Pendergrass, J.H. (Los Alamos Scientific Lab., NM); Booth, L.A.; Stark, E.; Cherdack, R.N. *Trans. Am. Nucl. Soc.;* **33**: 48-50(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30002 Capital cost data base for laser fusion power plants. Pendergrass, J.H. (Los Alamos Scientific Lab., NM); Booth, L.A.; Cherdack, R.N. *Trans. Am. Nucl. Soc.;* **33**: 51(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30003 TROFAN: a laser fusion system studies model. Leonard, E.M.; Pendergrass, J.H.; Booth, L.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* **33**: 52(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30004 Parametric studies of inertial confinement fusion economics. Meier, W.R.; Monsler, M.J. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc.;* **33**: 53-54(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30005 Parametric studies of an inertial confinement fusion reactor. Zuckerman, D.S.; Carosella, L.A. (McDonnell Douglas Corp., St. Louis, MO). *Trans. Am. Nucl. Soc.;* **33**: 54-55(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30006 Nuclear-pumped laser (NPL) fusion blanket optimization in space and time. Dolatshahi, F.; Gilligan, J.G. (Univ. of Illinois, Urbana). *Trans. Am. Nucl. Soc.;* **33**: 77-79(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30007 Electron-beam fusion coupled pellet neutronics. Ragheb, M.M.H. (Univ. of Illinois, Urbana); Moses, G.A.; Maynard, C.W. *Trans. Am. Nucl. Soc.;* **33**: 729-730(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 29297, 29340, 29567

30008 (DOE/ER—0045/2) **Alloy development for irradiation performance. Quarterly progress report for period ending March 31, 1980.** Ashdown, B.G. (comp.). (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 233p. NTIS, PC A11/MF A01.

This report is organized along topical lines in parallel to a Program Plan of the same title so that activities and accomplishments may be followed readily relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1, 2, 8, and 9 review activities on analysis and evaluation, test methods development, status of irradiation experiments, and corrosion testing and hydrogen permeation studies, respectively. These activities relate to each of the alloy development paths. Chapters 3, 4, 5, 6, and 7 present the ongoing work on each alloy development path. The Table of Contents is annotated for the convenience of the reader.

30009 (HEDL-SA—2145-FP) **Fusion materials high energy-neutron studies. A status report.** Doran, D.G.; Guinan, M.W. (Hanford Engineering Development Lab., Richland, WA (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract AC14-76FF02170. 36p. (CONF-800551—14). NTIS, PC A03/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The objectives of this paper are (1) to provide background information on the US Magnetic Fusion Reactor Materials Program, (2) to provide a framework for evaluating nuclear data needs associated with high energy neutron irradiations, and (3) to show the current status of relevant high energy neutron studies. Since the last symposium, the greatest strides in cross section development have been taken in those areas providing FMIT design data, e.g., source description, shielding, and activation. In addition, many dosimetry cross sections have been tentatively extrapolated to 40 MeV and integral testing begun. Extensive total helium measurements have been made in a variety of neutron spectra. Additional calculations are needed to assist in determining energy dependent cross sections.

30010 (HEDL-SA—2146-FP) **Nuclear data relevant to shield design of FMIT facility.** Carter, L.L.; Morford, R.J.; Wilcox, A.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 30p. (CONF-800551—15). NTIS, PC A03/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Nuclear data requirements are reviewed for the design of the Fusion Materials Irradiation Test (FMIT) facility. This accelerator-based facility, now in the early stages of construction at Hanford, will provide high fluences in a fusion-like radiation environment for the testing of materials. The nuclear data base required encompasses the entire range of neutron energies from thermal to 50 MeV. In this review, we consider neutron source terms, cross sections for thermal and bulk shield design, and neutron activation for the facility.

30011 (HEDL-SA—2147-FP) **Simulation of short-term annealing of displacement cascades in FCC metals.** Heinisch, H.L.; Doran, D.G.; Schwartz, D.M. (Hanford Engineering Development Lab., Richland, WA (USA); California State Univ., Northridge (USA)). 1980. Contract AC14-76FF02170. 17p. (CONF-800609—9). NTIS, PC A02/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

Computer models have been developed for the simulation of high energy displacement cascades. The objective is the generation of defect production functions for use in correlation analysis of radiation effects in fusion reactor materials. In particular, the stochastic cascade annealing simulation code SCAS has been developed and used to model the short-term annealing behavior of simulated cascades in FCC metals. The code is fast enough to make annealing of high energy cascades practical. Sets of cascades from 5 keV to 100 keV in copper were generated by the binary collision code MARLOWE.

30012 (HEDL-SA—2149) **CR-39 polymer, a promising new solid state track recorder for high energy neutron applications.** Ruddy, F.H.; Preston, C.C.; Gold, R.; Benton, E.V.; Roberts, J.H. (Hanford Engineering Development Lab., Richland, WA (USA); San Francisco Univ., CA (USA); Macalester Coll., Saint Paul, MN (USA)). 14 Apr 1980. Contract AC14-76FF02170. 22p. (CONF-800551—20). NTIS, PC A02/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

CR-39 Polymer, a new solid state track recorder with unprecedented sensitivity to lightly ionizing particles (such as protons) is being developed for eventual neutron dosimetry applications in the Fusion Materials Irradiation Test Facility and elsewhere. The diameters of proton tracks have been found to vary smoothly and reproducibly as a function of energy from 0.20 to 18.0 MeV. Preliminary results on the response of CR-39 polymer to proton tracks as a function of angle show a rapid decrease of the registration efficiency from 100% to 0 for angles of incidence less than 75°. Proton recoil track size distributions in CR-39 polymer irradiated with monoenergetic neutrons of varying energy are presented. Some proposed high energy neutron dosimetry and radiography systems using CR-39 polymer are discussed.

30013 (LA—8286-MS) **First wall magnetic protection in an inertially confined thermonuclear reactor.** Devaney, J.J. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01.

On the basis of three different theories, it is shown for a typical set of reactor parameters that inertially confined microexplosions are either (1) stable during early expansion; or (2) only weakly unstable during expansion with flute amplitude growth of but 0.005%; or (3) only weakly unstable during expansion with negligible flute amplitude growth. Simple formulas are given for skin depths in the plasma (~ 0.3 cm for 500°C graphite). Plasma behavior is found to be collective and ambipolar. Formulas are given for calculating the strength of the required protecting initial magnetic field. For a microexplosion putting 16-MJ kinetic energy into 0.25 g of lead debris, we find 3.2 kG to be adequate protection in a reactor chamber of 200-cm radius with a graphite (or other conducting) wall.

30014 (LA—8333-MS) **Comprehensive neutron cross-section and secondary energy distribution uncertainty analysis for a fusion reactor.** Gerstl, S.A.W.; LaBauve, R.J.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 62p. NTIS, PC A04/MF A01.

On the example of General Atomic's well-documented Power Generating Fusion Reactor (PGFR) design, this report exercises a comprehensive neutron cross-section and secondary energy distribution (SED) uncertainty analysis. The LASL sensitivity and uncertainty analysis code SENSIT is used to calculate reaction cross-section sensitivity profiles and integral SED sensitivity coefficients. These are then folded with covariance matrices and integral SED uncertainties to obtain the resulting uncertainties of three calculated neutronics design parameters: two critical radiation damage rates and a nuclear heating rate. The report documents the first sensitivity-based data uncertainty analysis, which incorporates a quantitative treatment of the effects of SED uncertainties. The results demonstrate quantitatively that the ENDF/B-V cross-section data files for C, H, and O, including their SED data, are fully adequate for this design application, while the data for Fe and Ni are at best marginally adequate because they give rise to response uncertainties up to 25%. Much higher response uncertainties are caused by cross-section and SED data uncertainties in Cu (26 to 45%), tungsten (24 to 54%), and Cr (up to 98%). Specific recommendations are given for re-evaluations of certain reaction cross-sections, secondary energy distributions, and uncertainty estimates.

30015 (SAND—79-2341C) **Saturation and isotopic replacement of deuterium in low-Z material.** Doyle, B.L.; Wampler, W.R.; Brice, D.K.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 26p. (CONF-800455—5). NTIS, PC A03/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

The saturation and replacement of hydrogen isotopes implanted into TiC, TiB_2, VB_2, B_4C, B, Si, and C has been examined experimentally and modeled theoretically. The deuterium saturation concentrations for these materials varied from .16 to .57. A new isotopic replacement model is presented which predicts isotopic trapping and exchange on the basis of the depth dependence of the implanted ions and the experimentally determined hydrogen saturation concentration. Our results indicate that, for these materials used as coatings on components in a D-T fueled tokamak, T recovery by ion induced replacement with H or D should be feasible and that T buildup will be at tolerable levels.

30016 (UCRL—82992) **Serial interprocessor communications system.** Labiak, W.; Siemens, P.; Bailey, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Menlo Computer Associates, Palo Alto, CA (USA)). 3 Apr 1980. Contract W-7405-ENG-48. 9p. (CONF-800464—2). NTIS, PC A02/MF A01.

From DECUS conference; Anaheim, CA, USA (19 Apr 1980).

A serial communications system based on the EIA RS232-C standard with modem control lines has been developed. The DLV11-E interface is used for this purpose. All handshaking is done with the modem control lines. This allows totally independent full duplex communication. The message format consists of eight bit data with odd parity and a sixteen bit checksum on the whole message. All communications are fully interrupt driven. A program was written to load a program into a remote LSI-11 using the serial line without bootstrap ROM.

30017 **Refractory oxides for fusion reactor first walls, the effects of the reducing environment.** Hoffman, J.G. (Los Alamos Scientific Lab., NM (USA)). *Rev. Int. Hautes Temp. Refract.;* **16**: No. 3, 245-254(1979).

From International colloquium on refractory oxides for high temperature energy sources; Odeillo, France (28 Jun - 1 Jul 1977).

Of the several applications for refractory oxides in fusion reactor systems, the most demanding is that for the first wall. Some components in proximity of the first wall (possibly waveguides or flux breakers) will also be subjected to similar environments. Many parameters affect the ultimate usability of a particular material for reactor applications: electrical resistivity and dielectric breakdown if applicable, thermal conductivity, mechanical properties, and stability with respect to neutral molecular or atomic, or ionized fuel gases. All these properties can be affected by the radiation environment present in an operating power reactor. Temperatures up to 2000K may be expected for radiatively cooled first wall liners in some proposed designs although surface temperatures are appreciably lower (approximately 1000K) in other applications. The exact nature of the chemical environment is not defined even for the most well developed design concepts, but possible environments may be hypothesized; ambient neutral molecular and atomic species, bombardment by high energy charge exchange neutral atoms, direct ionic bombardment from stray ions, and plasma dumps from failure of the confinement system. Preliminary work has begun to more adequate-

ly define the extent of the problem and suggest approaches to engineering solutions.

30018 Analytical modeling of void growth in ICFR first walls. Gurol, H. (Univ. of California, Santa Barbara); Ghoniem, N.M. *Trans. Am. Nucl. Soc.;* 33: 256-257(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30019 Interstitial loop formation in inertial confinement fusion reactors. Ghoniem, N.M.; Cho, D.D. (Univ. of California, Los Angeles). *Trans. Am. Nucl. Soc.;* 33: 257-258(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30020 Application of titanium alloys in fusion reactor blanket structures. Jones, R.H.; Charlot, L.A.; Leonard, B.R.; Johnson, A.B. Jr. (Battelle Pacific Northwest Labs., Richland, WA). *Trans. Am. Nucl. Soc.;* 33: 258-259(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30021 Analysis of ORNL fusion reactor shield integral experiments. Santoro, R.T. (Oak Ridge National Lab., TN); Alsmiller, R.G. Jr.; Barnes, J.M.; Chapman, G.T.; Morgan, G.L.; Oblow, E.M.; Peelle, R.W. *Trans. Am. Nucl. Soc.;* 33: 665-666(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30022 Experience with new cross-section covariance data in fusion neutronics applications. Gerstl, S.A.W.; Labauve, R.J. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 682-684(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30023 Neutron skyshine calculations for the PDX tokamak. Wheeler, F.J.; Nigg, D.W. (EG and G Idaho, Inc., Idaho Falls). *Trans. Am. Nucl. Soc.;* 33: 701-702(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30024 Convolution integral and its role in particle transport. Mack, J.M.; Hughes, H.G.; Soran, P.D. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 33: 711-713(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

30025 Neutron heating of levitated superconducting rings in a D-^{3}He multipole. Steele, W.G.; Gordon, J.D. (TRW, Inc., Redondo Beach, CA). *Trans. Am. Nucl. Soc.;* 33: 725-727(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

GENERAL AND MISCELLANEOUS

30026 Equality for women scientists. Bissell, M.J. (Univ. of California, Berkeley). *Grants Mag.;* 1: No. 4, 331-334(Dec 1978).

Factors which have traditionally kept women scientists at a professional level lower than that of male scientists, such as lack of recognition and status in academic communities and insufficient funding by federal agencies to pursue research projects, are discussed. (LCL)

MANAGEMENT

REFER ALSO TO CITATION(S) 29179

30027 (DOE/EIA—10587-01) Proceedings of the symposium to review Volume III of the Annual Report to Congress. Alt, F.; Norland, D. (Maryland Univ., College Park (USA). Coll. of Business and Management). 1979. Contract FG01-79EI10587. 549p. (CONF-791195—). NTIS, PC A23/MF A01.

From Symposium on review volume III of the 1978 annual report to congress; College Park, MD, USA (7 Nov 1979).

This report is a transcript of the proceedings of a two-day Symposium, held in the Fall of 1979 at the University of Maryland in order to independently review the 1978 Energy Information Administration (EIA) Annual Report to Congress (ARC), Volume III. Participants included energy forecasting experts from the academic community and the private sector; other Federal, State, and local government energy experts; and Office of Applied Analysis, EIA, staff members. The Symposium and its transcript are a critique of the underlying 1978 ARC assumptions, methodologies, and energy system projections. Discussions cover the short-, mid-, and long-term periods, national and international forecasts, source and consuming sectors and projected economic impacts. 27 figures, 22 tables.

30028 (DOE/IG—0001T) Annual report, Office of the Inspector General. Mansfield, J.K. (Department of Energy, Washington, DC (USA). Office of Inspector General). Mar 1980. 83p. NTIS, PC A05/MF A01.

Activities during the period January 1, 1979 through December 31, 1979 are reported. First, an overview of the progress and problems encountered by this office during the last calendar year is given. Next, certain matters of concern relating to the independence of the office and the ability to work effectively are discussed. Then progress being made and problems being met in forward planning are reviewed. The existing office organizational and staffing patterns are described in the subsequent section. Then weaknesses of the existing DOE overall audit system are discussed. Work done by the IG audit, inspection, and investigative staffs during 1979 is reviewed. Summaries of significant IG findings and recommendations, and of departmental responses thereto, are included. Finally, follow-through activities and certain developments during 1979 that were of importance to the office are described. (RWR)

30029 (LA—8318-MS) Publications of LASL research, 1978. Willis, J.K.; Salazar, C.A. (comps.). (Los Alamos Scientific Lab., NM (USA)). Apr 1980. Contract W-7405-ENG-36. 226p. NTIS, PC $16.50/MF $4.40.

This bibliography is a compilation of unclassified publications of work done at the Los Alamos Scientific Laboratory for 1978. Papers published in 1978 are included regardless of when they were actually written. Publications received too late for inclusion in earlier compilations are also listed. Declassification of previously classified reports is considered to constitute publication. All classified issuances are omitted. If a paper was published more than once, all places of publication are included. The bibliography includes Los Alamos Scientific Laboratory reports, papers released as non-LASL reports, journal articles, books, chapters of books, conference papers (whether published separately or as part of conference proceedings issued as books or reports), papers published in congressional hearings, theses, and US patents. Publications by LASL authors that are not records of Laboratory-sponsored work are also included.

30030 (LBL—10792) Mass storage systems and large research libraries. Baker, J.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 11p. (CONF-800472—2). NTIS, PC A02/MF A01.

From IEEE symposium on MASS storage; Denver, CO, USA (Apr 1980).

A scheme to reorganize large research libraries is presented. The scheme involves storing infrequently circulated books on a mass storage device in digital form. The proposed system would solve many problems associated with the proliferation of books and serials in research libraries.

30031 Role of contract research and development in industry. Gregory, D.P. Chicago, IL; Institute of Gas Technology (1980). 11p. (CONF-800483—1).

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The advantages of using a contract research institute for performing research and development tests for private industry are discussed. These are contrasted with university consultants, in-house R and D services, ad nonprofit R and D institutes. (DC)

30032 Design education - technical notes. Wilson, G.G. Seattle, WA; Institute of Gas Technology (1980). 9p. (CONF-800576—1).

From American Gas Association distribution conference; Detroit, MI, USA (19 May 1980).

Applications oriented educational and reference materials on industrial technology are chronically in short supply. A format for this type of publication, Technical Notes, and a procedure for producing them from Distribution Conference papers are presented.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 28763, 29032, 29033, 29037, 29038, 29723, 29830, 29837, 29842

30033 (ANL/AMD/TM—350) ILN RJE user's guide for PDP-11/RT-11 hosts. Henderson, L.; Lidinsky, W.; Meyer, C.; Rynes, P.; Weddige, R.; Zelle, B. (Argonne National Lab., IL (USA)). 31 Mar 1980. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01.

The Intra-Laboratory Network (ILN) is a general-purpose computer communications network located at ANL. This network provides error-free high-speed communications between computers connected to the network. In addition to its general-purpose capability, the ILN also provides a remote job entry (RJE) system that allows users to move files from the user's computer system to ANL's Central Computing Facility (CCF), move files from the CCF to the user's computer system, and check on the status of CCF jobs, cancel jobs, etc. This document describes the use of the ILN RJE system for users who have DEC PDP-11 computer systems running the RT-11 operating system. The ILN RJE system consists of three parts. Closest to the user is the ILN RJE utility program that runs on the user's host. Between the host and the CCF is the ILN which contains, in addition to the network control, an ILN RJE facility that supports the utility program and interfaces to the CCF. The third part is the CCF, which is accessed via the CCF front-end Varian V73 communications processors. The procedures for running the ILN RJE utility program are described. Then the commands that can be used to submit and retrieve jobs, check on job status, etc., are reviewed. Each command description includes the command syntax, a brief description of the function, and one or more examples. Next, several techniques for transferring files between a host and either the Central Computing Facility or another host are outlined. Appendixes summarize the ILN RJE system commands, and provide the ASCII/EBCDIC conversion table that is used in the ILN. (RWR)

30034 (BDX—613-2402) **Metrology data reduction system: PDP-11/34 computer system.** Cable, J.W. (Bendix Corp., Kansas City, MO (USA)). Apr 1980. Contract AC04-76DP00613. 48p. NTIS, PC A03/MF A01.

A PDP-11/34 computer system was installed to acquire, correct, scale, display, store, and process data obtained by microwave and dc area coupler controllers. The system is used to calibrate power sensors and impedance and dc measurement standards on a real-time basis. The microwave data input is from a digital voltmeter and scanner arrangement, which also may be controlled from a P-ROM control board. The dc data input is from a passive device interface or from a terminal keyboard. 5 figures, 8 tables.

30035 (CONF-800571—1) **Deciding on the best (in this case) approach to time-series forecasting.** Pack, D.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From Canadian Operations Research Society meeting; Quebec, Canada (20 May 1980).

This paper was motivated by a Decision Sciences article [v. 10, no. 2, 232-244(April 1979)] that presented comparisons of the adaptive estimation procedure (AEP), adaptive filtering, the Box-Jenkins (BJ) methodology, and multiple regression analysis as they apply to time-series forecasting with single-series models. While such comparisons are to be applauded in general, it is demonstrated that the empirical comparisons of the above paper are quite misleading with respect to choosing between the AEP and BJ approaches. This demonstration is followed by a somewhat philosophical discussion on comparison-of-methods techniques.

30036 (CONF-800644—1) **Estimators for the truncated beta-binomial distribution.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 32p. NTIS, PC A03/MF A01.

From 173. Institute of Mathematical Statistics conference; Davis, CA, USA (16 Jun 1980).

Let X have a beta-binomial(m,p,θ) distribution, truncated such that $X > t$ for $t = 0$ or 1. Suppose that independent observations of X are available. A consistent estimator of (p,θ) is given, based on the first three sample moments. This may be used as a start for maximum likelihood estimation or jackknifing. The standard assumptions for a $C(\alpha)$ is truncated binomial do not hold; however, a test is proposed based on jackknifing the sample variance of X. Some Monte Carlo comparisons are given. For moderately small data sets, these comparisons show that the moment estimator is often superior to the MLE, and the $C(\alpha)$ test is superior to other proposed tests, in spite of its lack of theoretical justification. 3 figures, 5 tables.

30037 (LBL—10239) **Computer-assisted chart making from the graphic designer's perspective.** Marcus, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 8p. (CONF-800720—1). NTIS, PC A02/MF A01.

From Conference of the Association for Computing Machinery, special interest group for graphics; Seattle, WA, USA (14 Jul 1980).

It is important to improve the aesthetics and effectiveness of information graphics through greater awareness of graphic design as a visual communication discipline. Chart making is one subject area in which graphic design awareness can be enhanced. Basic design principles are reviewed which are relevant to creating better charts. Examples demonstrate improvements. 4 figures, 1 table.

30038 (SAND—80-0538/4) **Remote hard copy. Volume 4, MODCOMP-NOVA interface programming manual.** Simons, R.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1980. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01.

This manual gives a detailed description of commands accepted by the MODCOMP-NOVA interface used in the remote hard-copy plotters. Following that, device drivers and diagnostic routines for the interface are documented. 4 figures, 1 table.

30039 (UCID—18721) **SI-to-customary conversion (SICON) program.** Burger, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

The SICON program is an interactive computer program to perform the conversion of all SI units to a customary set of units. The conversion is done in accordance with the standards set forth in ANSI 22101 (ASTM E380) Standard for Metric Practice. The intent here is to provide a quick, easy, and accurate method of SI unit conversion primarily in the manufacturing stage where units in SI drawings must be correctly converted to customary units. The majority of conversion operations will be for linear dimensions such as from mm to inches, but all other units such as form tolerance, mass, volume, force, energy, velocity, etc., are also possible. The program provides for interactive communication from an octopus terminal and a TV monitor display (TMDS) on the CDC 7600 computer. The data are entered from the terminal and can be viewed on the monitor. The converted units are then displayed on the monitor, and a hard copy is generated on the remote job entry terminal (RJET) printer on command. The hard copy with input and converted data serves as a document with the drawing for those working in customary units. The interactive environment of the program allows an operator to change, add, or delete any portion of the input data and generate the converted results instantly. 3 figures, 3 tables. (RWR)

30040 (UCRL—52852) **THOR: a post-processor for two-dimensional analysis codes.** Hallquist, J.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1980. Contract W-7405-ENG-48. 86p. NTIS, PC A05/MF A01.

A user's manual for the post-processor THOR is provided. THOR reads the binary plot files generated by the two-dimensional finite-element codes currently used at LLL and plots contours, time histories, and deformed shapes. Contours of a large number of quantities may be plotted on meshes consisting of triangular and variable node (4 to 8 nodes/element) quadrilateral elements. THOR can compute a variety of strain measures at either Gauss integration or nodal points, interface pressures along slide lines, reaction forces along constrained boundaries, response spectra, and momentum. THOR is operational on the CDC 7600 and Cray-1 computers. 10 figures.

30041 (UCRL—83929) **Multiple access mass storage network.** Wentz, D.L. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 15p. (CONF-800638—1). NTIS, PC A02/MF A01.

From Networks 80 international conference; London, UK (3 Jun 1980).

The Multi-Access Storage Subnetwork (MASS) is the latest addition to the Octopus computer network at Lawrence Livermore Laboratory. The subnetwork provides shared mass storage for the Laboratory's multiple-host computer configuration. A Control Data Corp. 38500 Mass Storage facility is interfaces by MASS to the large, scientific worker computers to provide an on-line capacity of 1 trillion bits of user-accessible data. The MASS architecture offers a very high performance approach to the management of large data storage, as well as a high degree of reliability needed for operation in the Laboratory's timesharing environment. MASS combines state-of-the-art digital hardware with an innovative system philosophy. The key LLL design features of the subnetwork that contribute to the high performance include the following: a data transmission scheme that provides a 40-Mbit/s channel over distances of up to 1000 ft, a large metal-oxide-semiconductor (MOS) memory buffer controlled by a 24-port memory multiplexer with an aggregate data rate of 280 Mbit/s, and a set of high-speed microprocessor-based controllers driving the commercial mass storage units. Reliability of the system is provided by a completely redundant network, including two control minicomputer systems. Also enhancing reliability is error detection and correction in the MOS memory. A hardware-generated checksum is carried with each file throughout the entire network to ensure integrity of user files. 6 figures, 1 table.

30042 **Numerical solution of Helmholtz's equation by implicit capacitance matrix methods.** Proskurowski, W. (Univ. of California, Berkeley). *ACM Trans. Math. Software;* 5: No. 1, 36-49(Mar 1979).

The numerical solution of Helmholtz's equation in an arbitrary bounded plane region is considered. Variants of the capacitance matrix method that greatly reduced storage requirements are developed. This approach allows the use of a very fine mesh with

several hundered mesh points in each direction or the use of a cmputer with a small core storage. 4 tables.

30043 Reconstruction of fan-beam data by filtering the back-projection. Gullberg, G.T. (Univ. of California, Berkeley). *Comput. Graphics Image Process.;* **10**: 30-47(1979).

Expressions for the fan-beam projection and back-projection operators are given along with an evaluation of the impulse response for the composite of the projection and back-projection operations. The fan-beam geometries for both curved and flat detectors have back-projection operators such that the impulse response for the composite of the projection and back-projection operations is equal to 1/mod $(r\text{-}r_0)$ if the data are taken over 360^0, and thus two-dimensional Fourier filter techniques can be used to reconstruct transverse sections from fan-beam projection data. It is shown that the impulse response for the composite of the projection and back-projection operators for fan-beam geometry is not spatially invariant if the data are taken over 180^0, as is true for parallel-beam projection data. The convolution algorithm is approximately four times faster and requires 40% less memory than the filter of the back-projection algorithm. However, the filter of the back-projection algorithm has the advantage of easily implementing different frequency space filters; this property allows easy change of the noise propagation vs resolution properties of the convolution kernal. 6 figures.

30044 Approximate percentage points for Pearson distributions. Bowman, K.O. (Union Carbide Corp., Oak Ridge, TN); Shenton, L.R. *Biometrika;* **66**: No. 1, 147-151(1979).

Approximate formulas for a set of percentage points of the Pearson system are given in terms of the skewness and kurtosis. 4 tables.

30045 Generating all permutations by graphical transpositions. Slater, P.J. (Sandia Lab., Albuquerque, NM). Contract AT(29-1)-789. *Ars Comb.;* **5**: 219-225(1978).

Let G be any connected graph with vertex set V(G) = (v_1, v_2, ..., v/sub n/). It is shown that there exists a sequence L_1, L_2, ..., L/sub n-fractorial/ of the permutations of (1, 2, ..., n) in which permutation L/sub i+1/ = (σ_1, σ_2, ..., σ/sub n/) differs from its predecessor L/sub i/ by the transposition of two elements, say σ/sub j/ and σ/sub k/, for which v/sub j/ and v/sub k/ are adjacent in G.

30046 Maximum likelihood estimation for the beta distribution. Beckman, R.J.; Tietjen, G.L. (Los Alamos Scientific Lab., NM). *J. Stat. Comput. Simul.;* **7**: 253-258(1978).

A fast method of calculating the two-parameter maximum-likelihood estimates of the beta distribution is given which does not require starting values and is generally free from convergence problems. 2 figures, 1 table.

30047 Centers to centroids in graphs. Slater, P.J. (Sandia Labs., Albuquerque, NM). *J. Graph Theory;* **2**: 209-222(1978).

For S contained in V(G) the S-center and S-centroid of G are defined as the collection of vertices u an element of V(G) that minimize e/sub s/(u) = max [d(u,v): v an element of S] and d/sub s/(u) = Σ/sub v an element of S/d(u,v), respectively. This procedure generalizes the standard definition of center and centroid from the special case of S = V(G). For $1 \leqq k \leqq$ absolute value V(G) and u an element of V(G) let r/sub k/(u) = max [Σ/sub s an element of S/d(u,s): S contained in V(G), absolute value S = k]. The k-centrum of G, denoted C(G;k), is defined to be the subset of vertices u in G for which r/sub k/(u) is a minimum. This approach also generalizes the standard definitions of center and centroid since C(G;1) is the center of C(G; absolute value V(G)) is the centroid. The structure of these sets for trees is examined. Generalizations of theorems of Jordan and Zelinka are included. 4 figures, 2 tables.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 29169

30048 (CONF-780506—(Vol.2), pp 858-864) **Technical center for transportation analyses.** Foley, J.T. (comp.). (Sandia Labs., Albuquerque, NM). 1978.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

A description is presented of an information search/retrieval/research activity of Sandia Laboratories which provides technical environmental information which may be used in transportation risk analyses, environmental impact statements, development of design and test criteria for packaging of energy materials, and transportation mode research studies. General activities described are: (1) history of center development; (2) environmental information storage/retrieval system; (3) information searches; (4) data needs identification; and (5) field data acquisition system and applications.

30049 What's new in environmental information. Vaughan, N. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc.;* **33**: 163(1979). (CONF-791103—).

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Aerojet Energy Conversion Co., Sacramento, CA (USA)
Evaluation of fluid bed heat exchanger optimization parameters. Final report, 5:29261 (DOE/ET/11343—T1)

Aerospace Corp., El Segundo, CA (USA)
Laser excited nonresonant fluorescence spectroscopy. Second annual progress report, 5:29777 (ATR—80(7783)-1)

Allegheny-Singer Research Corp., Pittsburgh, PA (USA). Cancer Research Labs.
Effects of chemical carcinogens on the susceptibility of C57BL/10 and (SJL/J x C57BL/10) F_1 hybrids to Friend leukemia virus, 5:29732 (COO—4800-8)

Allied-General Nuclear Services, Barnwell, SC (USA)
Advanced access control system, 5:28534 (AGNS—35900-CONF-67)
Advanced integrated safeguards at Barnwell, 5:28535 (AGNS—35900-CONF-81)
Automated calibrations and dynamic corrections for differential pressure transmitters, 5:28533 (AGNS—35900-CONF-65)

Altas Corp., Santa Cruz, CA (USA)
Statistical model for assessing the risk of hail damage to any ground installation. Technical report, June 1978-March 1979, 5:28763 (ALO—4291-1)

Aluminum Co. of America, Alcoa Center, PA. Alcoa Technical Center
Performance of a technical and economical feasibility study of an hvdc compressed gas insulated transmission line. Technical status report No. 6 for the period of May 1980, 5:28938 (DOE/ET/29355—T6)

Ames Lab., IA (USA)
Dielectric heating in mixtures containing coal and pyrite, 5:28364 (IS—4738)

AN SSSR, Moscow. Fizicheskij Inst.
Estimate of the quark-gluon coupling constant, 5:29799 (SLAC-Trans—0190)

Applied Resource Integration Ltd., Boston, MA (USA)
Accessible bus service in St. Louis. Final report. UMTA/TSC project evaluation series, 5:29255 (UMTA-MA—06-0049-80-6)

Applied Technology Corp., Norman, OK (USA)
Control and extinguishment of LPG fires. Final report, 5:28399 (DOE/EV/06020—T2)

ARCAED, London (UK)
Investigation of passive heating and cooling work in Europe, 5:28740 (EUR—6695-EN)

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	5:29160	DOE/NASA/1034—8
AI01-79ET20397	Jet Propulsion Lab., Pasadena, CA (USA)	
	5:28651	DOE/JPL—1060-35
AI05-80OR20687	Bureau of Mines, Albany, OR (USA). Albany Metallurgy Research Center	
	5:28272	DOE/OR/20687—T1
AI08-76DP00474	Geological Survey, Denver, CO (USA)	
	5:29759	USGS—474-266
	5:29765	USGS—474-310

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AM02-76CH03073	Princeton Univ., NJ (USA). Plasma Physics Lab.	
	5:29877	PPPL—1669
	5:29883	PPPL—1668
AM03-76SF00012	California Univ., Los Angeles (USA)	
	5:28652	DOE/SF/00012—T1
AM03-76SF00893	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
	5:28470	GEFR-SP—215
AM03-76SF01101	Aerospace Corp., El Segundo, CA (USA)	
	5:29777	ATR—80(7783)-1
AS01-77ET10482	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
	5:29370	FE—2710-4
AS01-77ET10533	West Virginia Univ., Morgantown (USA). Coal Research Bureau	
	5:28361	DOE/ET/10533—8
AS01-77ET10618	Worcester Polytechnic Inst., MA (USA)	
	5:28264	FE—2702-10
AS01-78ET10741	Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research	
	5:28573	FE—3177-5
AS02-76ER02166	Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering	
	5:29295	DOE/ER/02166—26
AS02-76ER02280	Northwestern Univ., Evanston, IL (USA)	
	5:29829	COO—2280-39
AS02-76ER03158	Cornell Univ., Ithaca, NY (USA). Materials Science Center	
	5:29384	DOE/ER/03158—88
AS02-76ER03420	Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering	
	5:29349	CONF-780545—11
AS02-76ET53051	Wisconsin Univ., Madison (USA)	
	5:29958	COO—2387-120
AS02-76EV00790	Illinois Univ., Urbana (USA). Dept. of Botany	
	5:29701	DOE/EV/00790—1
AS02-76EV01300	Wisconsin Univ., Madison (USA)	
	5:29676	COO—1300-44
AS02-76EV12195	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology	
	5:29577	COO—2195-33
AS02-77ET10460	Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science	
	5:29294	COO—4246-12/13
AS02-77EV04366	Harvard Univ., Cambridge, MA (USA)	
	5:29677	COO—4366-2
AS02-77EV04580	New England Aquarium Corp., Boston, MA (USA)	
	5:29742	COO—4580-2
AS02-78ER05002	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering	
	5:29286	DOE/ER/05002—8
	5:29287	DOE/ER/05002—9
AS02-78ET27148	Colorado School of Mines, Golden (USA). Dept. of Geophysics	
	5:29761	DOE/ET/27148—1
AS02-78EV04800	Allegheny-Singer Research Corp., Pittsburgh, PA (USA). Cancer Research Labs.	
	5:29732	COO—4800-8
AS02-78EV04963	Wyoming Univ., Laramie (USA). Dept. of Botany	
	5:29707	DOE/EV/04963—1
AS02-79ER10456	Johns Hopkins Univ., Baltimore, MD (USA)	
	5:28368	DOE/ER/10456—1
AS03-77ER01359	Harvey Mudd Coll., Claremont, CA (USA)	
	5:29086	DOE/ER/01359—T1
AS05-76ER03992	Texas Univ., Austin (USA). Center for Particle Theory	
	5:29856	ORO—3992-280
AS05-76EV04182	Howard Univ., Washington, DC (USA)	
	5:29684	DOE/EV/04182—10
AS05-76EV04700	Arkansas Univ., Fayetteville (USA). Dept. of Agronomy	
	5:29617	ORO—4700
AS05-77ET20335	Clarkson Coll. of Tech., Potsdam, NY (USA). Dept. of Chemistry	
	5:28676	ORO—5440-2
AS05-78ER05773	George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science	
	5:29418	DOE/ER/05773—2
AS05-78ER05940	Maryland Univ., College Park (USA). Computer Science Center	
	5:29772	CONF-7910122—13
AS05-78ET37506	Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering	
	5:28980	ORO—6078-2
	5:29067	ORO—6078-1
AS05-79ER10436	Emory Univ., Atlanta, GA (USA). Dept. of Physics	
	5:29854	DOE/ER/10436—1
AS06-76ET20355	Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences	
	5:28907	RLO—2439-79/3
AS06-77ET28476	Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center	
	5:28840	DOE/ET/28476—T1
AS09-76EV00889	Skidaway Inst. of Oceanography, Savannah, GA (USA)	
	5:29632	DOE/EV/00889—T1
	5:29766	DOE/EV/00889—T2
AS09-76EV00901	Skidaway Inst. of Oceanography, Savannah, GA (USA)	
	5:29621	DOE/EV/00901—T1
AS09-76EV00936	National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center	
	5:29622	DOE/EV/00936—T1
	5:29623	DOE/EV/00936—T2
AS09-77SR01025	Skidaway Inst. of Oceanography, Savannah, GA (USA)	
	5:29583	DOE/SR/01025—T1
AS22--78ET00222	Cincinnati Univ., OH (USA). Dept. of Environmental Health	
	5:28374	DOE/ET/00222—5
AT02-76CH92092	Battelle Columbus Labs., OH (USA)	
	5:28267	BMI—2059
AT03-76ET35300	General Atomic Co., San Diego, CA (USA)	
	5:29088	GA-A—15439
AT03-76ET51011	General Atomic Co., San Diego, CA (USA)	
	5:29864	GA-A—15951
	5:29881	GA-A—15899
	5:29951	GA-A—15924
AT03-76SF71023	General Atomic Co., San Diego, CA (USA)	
	5:28977	GA—15936
AT03-79ET15391	California Univ., Santa Barbara (USA). Community and Organization Research Inst.	
	5:28393	DOE/EIA—6039-01
AT06-76EV70048	Washington Univ., Seattle (USA). Dept. of Chemistry	
	5:28858	DOE/EV/70048—2
EC-77-C-03-1470	Dynatrend, Inc., Arlington, VA (USA)	
	5:29223	SAN—1470-T2(App.D)
	5:29270	SAN—1470-T2(App.E)
EF-77-C-01-2614	Avco-Everett Research Lab., Inc., Everett, MA (USA)	
	5:29211	DOE/FE/2614—3
EF-77-C-01-2621	International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center	
	5:28291	FE—2621-13
EF-77-C-01-2689	Germantown Labs., Inc., Philadelphia, PA (USA)	
	5:28371	FE—2689-4
EF-77-S-01-2762	Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering	
	5:28372	FE—2762-8
EG-77-A-29-1078	Hoffman Maritime Consultants, Inc., Glen Head, NY (USA)	
	5:28661	DOE/NOAA/OTEC—2(AppendixC)
	5:28662	DOE/NOAA/OTEC—3
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	5:28667	DOE/NOAA/OTEC—10
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	5:28671	DOE/NOAA/OTEC—19
	5:28672	DOE/NOAA/OTEC—20
	5:28673	DOE/NOAA/OTEC—21
	5:28674	DOE/NOAA/OTEC—22
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	5:28679	DOE/NOAA/OTEC—9

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EG-77-C-01-4042	Solar Energy Research Inst., Golden, CO (USA)	
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	5:28615	SERI/PR—0-8274-2
	5:28616	SERI/PR—8274-1
	5:28640	DSE—4042-T16
	5:28815	SERI/TR—333-359
	5:29188	SERI/TR—434-424
EG-77-C-02-4388	Dynatech R/D Co., Cambridge, MA (USA)	
	5:28619	COO—4388-11
EG-77-C-03-1308	L'Garde, Inc., Newport Beach, CA (USA)	
	5:28884	SAN—1308-2
EG-77-C-07-1528	Gruy Federal, Inc., Houston, TX (USA)	
	5:28888	NVO—1528-6
EG-77-C-08-1528	Gruy Federal, Inc., Houston, TX (USA)	
	5:28878	NVO—1528-4
EG-77-C01-4042	Delaware Univ., Newark (USA). Inst. of Energy Conversion	
	5:28606	DSE—4042-3
EG-77-G-01-4085	Tao (William) and Associates, St. Louis, MO (USA)	
	5:28735	DOE/NASA/CR—161420
EM-78-C-01-4212	Reimann-Buechner Partnership, Syracuse, NY (USA)	
	5:29264	CONS—4212-T1
	5:29265	CONS—4212-T2
EM-78-C-01-4214	The Woodlands Development Corp., TX (USA)	
	5:29219	CONS—4214-T1(App.2)
	5:29266	CONS—4214-T1
	5:29267	CONS—4214-T1(App.1)
EM-78-C-01-5165	Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.	
	5:29163	LMSC-D—681417
EM-78-C-02-4977	Public Service Electric and Gas Co., Newark, NJ (USA)	
	5:29268	COO—4977/1(Vol.4)
EM-78-C-04-4291	Altas Corp., Santa Cruz, CA (USA)	
	5:28763	ALO—4291-1
ET-77-C-01-8914-002	Skelly and Loy, Harrisburg, PA (USA)	
	5:28350	FE—8914-2
ET-77-C-01-8914-003	Skelly and Loy, Harrisburg, PA (USA)	
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ET-77-C-01-8914-004	Skelly and Loy, Harrisburg, PA (USA)	
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ET-77-C-01-8914-005	Skelly and Loy, Harrisburg, PA (USA)	
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ET-77-C-01-8914-006	Skelly and Loy, Harrisburg, PA (USA)	
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ET-77-C-01-8914-007	Skelly and Loy, Harrisburg, PA (USA)	
	5:28354	FE—8914-7(App.)
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ET-77-C-01-8915	Ketron, Inc., Wayne, PA (USA)	
	5:28357	FE—8915(2)-1
ET-78-A-03-2208	Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.	
	5:28597	DOE/ET/32208—4
ET-78-C-01-2855	TRW Defense and Space Systems Group, Redondo Beach, CA (USA). Chemistry and Chemical Engineering Lab.	
	5:28565	FE—2855-6
ET-78-C-01-3167	United Technologies Research Center, East Hartford, CT (USA)	
	5:28325	FE—3167-T9
ET-78-C-01-3205	General Electric Co., Schenectady, NY (USA). Metallurgy Lab.	
	5:29279	CONS—3205-T1
ET-78-C-01-3269	Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.	
	5:28333	FE—3269-8A
ET-78-C-03-2198	Southwest Research Inst., San Antonio, TX (USA)	
	5:28752	DOE/CS/32198—1
ET-78-C-08-1558	Gruy Federal, Inc., Arlington, VA (USA)	
	5:28843	NVO—1558-6
ET-78-G-01-3070	Pennsylvania State Univ., University Park (USA). School of Forest Resources	
	5:28623	DSE—3070-T1
ET-79-S-02-5141	Connecticut Univ., Storrs (USA)	
	5:28621	DOE/ET/23066—4
EW-76-C-21-8024	Guyan Oil Co., Inc., Huntington, WV (USA)	
	5:28386	DOE/METC/8024—T1
EX-76-A-29-1024	Tao (William) and Associates, St. Louis, MO (USA)	
	5:28735	DOE/NASA/CR—161420
EX-76-C-01-1792	Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)	
	5:28274	FE—1792-55
EX-76-C-01-1793	Foster-Miller Associates, Inc., Waltham, MA (USA)	
	5:28275	FE—1793-50
EX-76-C-01-1806	General Electric Co., Schenectady, NY (USA). Gas Turbine Div.	
	5:28914	FE—1806-83
	5:28915	FE—1806-84
EX-76-C-01-2270	Catalytic, Inc., Wilsonville, AL (USA)	
	5:28313	EPRI-AF—1287
EX-76-C-01-2305	Gulf Research and Development Co., Pittsburgh, PA (USA)	
	5:28315	FE—2305-30
EX-76-C-01-2306	Suntech, Inc., Marcus Hook, PA (USA). Research and Engineering Div.	
	5:28316	FE—2306-32
	5:28317	FE—2306-35
EX-76-C-01-2331	Science Applications, Inc., El Segundo, CA (USA)	
	5:28671	DOE/NOAA/OTEC—19
EX-76-C-01-2357	General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.	
	5:28370	FE—2357-59
	5:28916	FE—2357-50
EX-77-C-01-2685	Thermo Electron Corp., Waltham, MA (USA)	
	5:28917	TE—4231-117-78(Vol.1)
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	5:28919	TE—4231-117-78(Exec.Summ.)
EY-76-C-02-0016	Brookhaven National Lab., Upton, NY (USA)	
	5:29467	BNL—27598
EY-76-C-02-2681	Hydronautics, Inc., Laurel, MD (USA)	
	5:28674	DOE/NOAA/OTEC—22
	5:28675	DOE/NOAA/OTEC—23
EY-76-C-03-0012	California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology	
	5:29689	UCLA—12-1239
EY-76-C-03-0115-140	SRI International, Menlo Park, CA (USA)	
	5:28807	DOE/ET/20550—1
EY-76-C-03-1137	San Diego Gas and Electric Co., CA (USA)	
	5:28875	SAN—1137-14
EY-76-C-03-1176	SRI International, Menlo Park, CA (USA)	
	5:29252	SAN—1176-T5
EY-76-C-03-1202	Rockwell International Corp., Anaheim, CA (USA)	
	5:28609	SAN—1202-78/1
	5:28610	SAN—1202-78/2
EY-76-C-03-1285	Southern Methodist Univ., Dallas, TX (USA)	
	5:28611	SAN—1285-T2
EY-76-C-04-0053	Mound Facility, Miamisburg, OH (USA)	
	5:29603	MLM—2703(OP)
EY-76-C-04-0656	General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.	
	5:29280	GEPP-TIS—494
	5:29343	GEPP-TIS—493
EY-76-C-04-0789	Sandia Labs., Albuquerque, NM (USA)	
	5:28440	CONF-780506—(Summ.)
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	5:28450	CONF-780506—(Vol.2)
	5:29335	SAND—80-0839C
	5:29556	SAND—80-0843C
	5:30015	SAND—79-2341C
EY-76-C-06-1830		
EY-76-C-07-1570	EG and G Idaho, Inc., Idaho Falls (USA)	
	5:29083	CONF-800723—15
EY-76-C-14-2170	Hanford Engineering Development Lab., Richland, WA (USA)	
	5:29297	HEDL-SA—1927
EY-76-S-06-2230-004	Oregon Univ., Eugene (USA)	
	5:29792	DOE/ER/70004—261
EY-77-C-21-8085	TRW Energy Systems Management Div., Redondo Beach, CA (USA)	
	5:28270	DOE/METC/8085—3
	5:28271	DOE/METC/8085—4
FC07-79ID12013	Wyoming Geothermal Commercialization Office, Laramie (USA)	
	5:28865	DOE/ID/12013—2
FC20-78LC10036	Occidental Oil Shale, Inc., Grand Junction, CO (USA)	
	5:28408	DOE/LC/10036—T3

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FG01-77ET10583	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)	
	5:28310	DOE/ET/10583—T1
FG01-78CS6904€	Montana Dept. of Natural Resources and Conservation, Helena (USA)	
	5:29206	DOE/TIC—10234
FG01-78ET12328	Michigan Technological Univ., Houghton (USA)	
	5:28369	DOE/ET/12328—T1
FG01-79EI10587	Maryland Univ., College Park (USA). Coll. of Business and Management	
	5:30027	DOE/EIA—10587-01
FG01-79RG09154	Illinois Office of Consumer Services, Springfield (USA)	
	5:29199	DOE/RG/09154—T1
FG02-79R510160	La Crosse, WI, YW/YMCA (USA)	
	5:29246	DOE/R5/10160—2
NAS-7-100-954339	Battelle Columbus Labs., OH (USA)	
	5:28598	DOE/JPL/954339—80/16-17
NAS-7-100-954355	Mobil Tyco Solar Energy Corp., Waltham, MA (USA)	
	5:28599	DOE/JPL/954355—80-1
NAS-7-100-954847	Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group	
	5:28600	DOE/JPL/954847—80/7
NAS-7-100-954886	Siltec Corp., Menlo Park, CA (USA)	
	5:28601	DOE/JPL/954886—80/10
NAS-7-100-955164	Bernd Ross Associates, San Diego, CA (USA)	
	5:28602	DOE/JPL/955164—79/4
NAS-7-100-955298	Spectrolab, Inc., Syimar, CA (USA)	
	5:28603	DOE/JPL/955298—80/2
NAS-7-100-955382	Massachusetts Inst. of Tech., Cambridge (USA)	
	5:28604	DOE/JPL/955382—79/5
W-31-109-ENG-38	Argonne National Lab., IL (USA)	
	5:28365	ANL/CEN/FE—78-14
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W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
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W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore National Lab.	
	5:28301	UCRL—84083
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	5:28476	UCRL—15253
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CONF-791187-	(Symposium on pulse combustion technology for heating applications, Argonne, IL, USA, 29-30 Nov 1979)	
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CONF-791195-		(Symposium on review volume III of the 1978 annual report to congress, College Park, MD, USA, 7-8 Nov 1979)
	5:30027	*See* DOE/EIA-10587-01
CONF-791204-		(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)
36	5:28893	*See* BNL-27546
37	5:28552	*See* BNL-27782
38	5:28366	*See* BNL-27783
CONF-791232-		(Thermal energy storage review meeting, Tysons Corner, VA, USA, 3 Dec 1979,-4 Dec 1979/REPLACES CONF-791242)
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CONF-791234-		(Environmental decontamination workshop, Oak Ridge, TN, USA, 4-5 Dec 1979)
6	5:29847	*See* RHO-SA-153
CONF-800111-		(Annual conference of the American Association for the Advancement of Science, San Francisco, CA, USA, 4 Jan 1980)
4	5:29235	NTIS, PC A02/MF A01
CONF-800140-		(Electro Optics conference, Tokyo, Japan, 23-26 Jan 1980)
1	5:29988	*See* UCRL-83204
CONF-800204-		(Energy-sources technology conference, New Orleans, LA, USA, 3-7 Feb 1980)
10	5:28488	*See* LBL-10517
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12	5:29817	*See* BNL-27985
CONF-800239-		(ICN-UCLA symposium, Keystone, CO, USA, 17 Feb-21 Mar 1980)
1	5:29639	NTIS, PC A02/MF A01
CONF-800240-		(Deep underwater muon and neutrino detection signal processing workshop, Honolulu, HI, USA, 11-16 Feb 1980)
2	5:29546	*See* LBL-10547
CONF-800242-		(Symposium on geothermal well stimulation, San Francisco, CA, USA, 7 Feb 1980)
1	5:28891	*See* LA-UR-80-1713
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CONF-800244-		(ASME, IEEE, and Society of Professional Engineer Joint meeting, New London, CT, USA, 19 Feb 1980)
1	5:28468	*See* DP-MS-80-25
CONF-800245-		(Workshop on subsurface seismic studies, Seattle, WA, USA, 20 Feb 1980)
1	5:29763	*See* DP-MS-80-16
CONF-800307-		(Fiber optic in the nuclear environment symposium, Adelphi, MD, USA, 25 Mar 1980,-27 Mar 1980/REPLACES CONF-800322)
7	5:29574	*See* LA-UR-80-1107
CONF-800320-		(3. topical conference on high temperature plasma diagnostics, Los Angeles, CA, USA, 17-19 Mar 1980)
4	5:29877	*See* PPPL-1669
CONF-800327-		(2. joint conference on applications of air pollution meteorology, New Orleans, LA, USA, 24-27 Mar 1980)
13	5:29602	*See* DP-MS-79-76
CONF-800334-		(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)
9	5:29603	*See* MLM-2703(OP)
14	5:29443	*See* UCRL-83749
CONF-800336-		(Radiopharmaceuticals: structure activity relationships symposium, Hartford, CT, USA, 21-23 Mar 1980)
2	5:29726	*See* BNL-27794
CONF-800340-		(DOE active solar heating and cooling contractors' review meeting, Lake Tahoe, NV, USA, 26-28 Mar 1980)
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2	5:29640	NTIS, PC A02/MF A01
CONF-800352-	(7. energy technology conference and exposition, Washington, DC, USA, 24-26 Mar 1980)	
4	5:28814	*See* SERI/TP-733-617
CONF-800374-	(15. Rencontre de Moriond, Les Arcs, France, 9-21 Mar 1980)	
4	5:29803	*See* COO-3130-423
CONF-800378-	(Genetic control of natural resistance to infection and malignancy, Montreal, Canada, 18-20 Mar 1980)	
1	5:29732	*See* COO-4800-8
CONF-800379-	(Workshop on modern developments in marine condensers, Monterey, CA, USA, 26-28 Mar 1980)	
1	5:28874	NTIS, PC A02/MF A01
CONF-800382-	(1980 Canadian energy exposition, Toronto, Canada, 15-23 Mar 1980)	
1	5:28567	Chicago, IL; Institute of Gas Technology (1980).
CONF-800384-	(Electric Power Research Institute workshop on energy and the developing nations, Stanford, CA, USA, 19 Mar 1980)	
1	5:29184	*See* LBL-10538
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1	5:29641	*See* LBL-10947
CONF-800401-	(2. international conference of liquid metal technology for energy systems, Richland, WA, USA, 20-24 Apr 1980)	
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CONF-800414-	(DECUS spring symposium, Chicago, IL, USA, 22-25 Apr 1980)	
5	5:29978	*See* KMSF-U-967
CONF-800417-	(European Physicists Society and Swiss National Science Foundation conference, Zurich, Switzerland, 9-11 Apr 1980)	
3	5:29827	*See* BNL-27566
CONF-800427-	(Tritium technology in fission, fusion, and isotopic applications, Dayton, OH, USA, 29 Apr-1 May 1980)	
13	5:29725	NTIS, PC A02/MF A01
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CONF-800428-	(6. international conference on fluidized bed combustion, Atlanta, GA, USA, 9-11 Apr 1980)	
5	5:28367	*See* BNL-27840
CONF-800439-	(International conference on metallurgical coatings, San Diego, CA, USA, 21-25 Apr 1980)	
9	5:28551	*See* UCRL-83532
10	5:29359	*See* HEDL-SA-1979
11	5:28812	*See* SAND-80-1045C
CONF-800451-	(5. annual heat pump technology conference, Stillwater, OK, USA, 14-15 Apr 1980)	
2	5:28734	*See* COO-4094-80
CONF-800452-	(International conference on nuclear behavior at high angular momentum, Strassbourg, France, 22-24 Apr 1980)	
3	5:29815	NTIS, PC A02/MF A01
CONF-800455-	(4. international conference on plasma surface interactions in controlled fusion devices, Garmisch, F.R. Germany, 21-25 Apr 1980)	
5	5:30015	*See* SAND-79-2341C
12	5:29882	NTIS, PC A02/MF A01
16	5:29883	*See* PPPL-1668
CONF-800464-	(DECUS conference, Anaheim, CA, USA, 19 Apr 1980)	
2	5:30016	*See* UCRL-82992
CONF-800471-	(Seminar on theory and applications of Monte Carlo methods, Oak Ridge, TN, USA, Apr 1980)	
5	5:29818	*See* HEDL-SA-2072-FP
CONF-800472-	(IEEE symposium on MASS storage, Denver, CO, USA, Apr 1980)	
2	5:30030	*See* LBL-10792
CONF-800480-	(ASCOT program planning meeting, Gettysburg, PA, USA, 15-18 Apr 1980)	
1	5:29579	*See* UCRL-84092
3	5:28897	*See* UCRL-84503
3	5:29769	*See* UCRL-84544
CONF-800481-	(User's Association annual meeting, Las Cruces, NM, USA, 15-17 Apr 1980)	
1	5:28631	*See* UCRL-84411
CONF-800482-	(Bio-energy world congress and exposition, Atlanta, GA, USA, 21-24 Apr 1980)	
1	5:28633	Chicago, IL; Institute of Gas Technology (1980).
CONF-800483-	(2. annual conference on industrial energy conservation technology and exhibition, Houston, TX, USA, 13-16 Apr 1980)	
1	5:30031	Chicago, IL; Institute of Gas Technology (1980).
CONF-800484-	(Reversed field pinch theory workshop, Los Alamos, NM, USA, 28 Apr-2 May 1980)	
1	5:29955	*See* UCRL-84450
CONF-800486-	(National energy users conference for transportation, San Antonio, TX, USA, 13-16 Apr 1980)	
1	5:29250	NTIS, PC A03/MF A01
CONF-800489-	(Gettysburg ASCOT meeting, Kelseyville, CA, USA, 14 Apr 1980)	
1	5:29589	*See* LA-UR-80-1824
CONF-800492-	(Southeastern conference on theoretical and applied mechanics, Knoxville, TN, USA, 17-18 Apr 1980)	
1	5:29587	*See* DP-MS-80-13
CONF-800494-	(28. relay conference, Stillwater, OK, USA, 29-30 Apr 1980)	
	5:29488	Elkhart, IN; National Association of Relay Manufacturers (1980).
CONF-800517-	(26. annual technical meeting of the Institute for Environmental Sciences, Philadelphia, PA, USA, 11-14 May 1980)	
6	5:28901	*See* RFP-3072
CONF-800540-	(International symposium on highly excited states in nuclear reactions, Osaka, Japan, 12-16 May 1980)	
2	5:29809	*See* DOE/ER/01388-443
CONF-800542-	(Concrete decontamination workshop, Seattle, WA, USA, 28-29 May 1980)	
4	5:29079	NTIS, PC A02/MF A01
CONF-800551-	(Symposium on neutron cross sections from 10 - 50 MeV, Upton, NY, USA, 12-14 May 1980)	
14	5:30009	*See* HEDL-SA-2145-FP
15	5:30010	*See* HEDL-SA-2146-FP
19	5:29816	*See* HEDL-SA-2134-FP
20	5:30012	*See* HEDL-SA-2149
CONF-800553-	(4. workshop on catalytic combustion, Cincinnati, OH, USA, 14-15 May 1980)	
2	5:29272	*See* BNL-27792
CONF-800557-	(10. annual symposium on the analytical chemistry of pollutants, Dortmund, F.R. Germany, 28-30 May 1980)	
1	5:29754	NTIS, PC A02/MF A01
CONF-800560-	(International conference on air pollutants and their effects on the terrestrial ecosystem, Banff, Alberta, Canada, May 1980)	
1	5:29586	NTIS, PC A05/MF A01
2	5:29585	*See* BNL-27956
CONF-800563-	(SPE international symposium on oil field and geothermal chemistry, Stanford, CA, USA, 28-30 May 1980)	
1	5:28385	NTIS, PC A02/MF A01

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CONF-800567-	(International symposia alternative energy sources and technology, Montreal, Canada, 28-30 May 1980)	
1	5:28653	*See* SERI/TP-731-706
2	5:28624	*See* LA-UR-80-1426
CONF-800568-	(28. annual conference on mass spectrometry and allied topics, New York, NY, USA, 25-30 May 1980)	
1	5:29377	NTIS, PC A02/MF A01
CONF-800571-	(Canadian Operations Research Society meeting, Quebec, Canada, 20-22 May 1980)	
1	5:30035	NTIS, PC A02/MF A01
CONF-800574-	(IMOG meeting held on subgroup environmental testing, Albuquerque, NM, USA, 20 May 1980)	
3	5:29435	*See* SAND-80-1433C
CONF-800575-	(4. SESA international congress on experimental mechanics, Boston, MA, USA, 25-30 May 1980)	
2	5:29046	*See* UCRL-84079
CONF-800576-	(American Gas Association distribution conference, Detroit, MI, USA, 19-21 May 1980)	
1	5:30032	*See* tle, WA; Institute of Gas Technology (1980).
CONF-800579-	(2. technical committee meeting on atomic and molecular (a+m) data for fusion, Paris, France, 19-22 May 1980)	
1	5:29778	NTIS, PC A02/MF A01
CONF-800580-	(American Gas Association transmission conference, Salt Lake City, UT, USA, 5-7 May 1980)	
1	5:28566	Chicago, IL; Institute of Gas Technology (1980).
CONF-800584-	(Fish and wildlife service workshop, Ft Collins, CO, USA, 28 May 1980)	
1	5:28495	*See* SAND-80-1319C
CONF-800585-	(7. scientific meeting of the International Society of Hypertension, New Orleans, LA, USA, 11-14 May 1980)	
1	5:29700	*See* BNL-27870
CONF-800586-	(ANS topical meeting, Dayton, OH, USA, 1 May 1980)	
1	5:29605	*See* UCRL-83294
CONF-800587-	(International cryogenic materials conference, Upton, NY, USA, 28-29 May 1980)	
1	5:29299	*See* UCRL-84040
2	5:29851	NTIS, PC A02/MF A01
3	5:29850	*See* BNL-28001
4	5:29307	*See* BNL-27964
CONF-800588-	(International symposium on high energy e+e- interactions, Nashville, TN, USA, 1-3 May 1980)	
1	5:29795	*See* LBL-10924
CONF-800590-	(AIAA international meeting and technical display global technology 2000, Baltimore, MD, USA, 6-8 May 1980)	
1	5:28553	*See* BNL-27891
CONF-800591-	(International conference on oxygen and oxy-radicals in chemistry and biology, Austin, TX, USA, 26-29 May 1980)	
1	5:29710	*See* NDRL-2107
CONF-800593-	(American Geological Society Rocky Mountain Section meeting, Ogden, UT, USA, 16-17 May 1980)	
1	5:28422	*See* DP-MS-79-101
CONF-800602-	(Symposium on instrumentation and control for fossil energy processes, Virginia Beach, VA, USA, 9-11 Jun 1980)	
7	5:28268	NTIS, PC A02/MF A01
CONF-800604-	(American section of the International Solar Energy Society conference, Phoenix, AZ, USA, 2-6 Jun 1980)	
32	5:28612	*See* SAND-79-2270C
CONF-800607-	(American Nuclear Society annual meeting, Las Vegas, NV, USA, 8-13 Jun 1980)	
36	5:29022	NTIS, PC A02/MF A01
45	5:29064	NTIS, PC A02/MF A01
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48	5:29080	NTIS, PC A02/MF A01
51	5:29081	NTIS, PC A02/MF A01
57	5:29023	NTIS, PC A02/MF A01
61	5:28977	*See* GA-15936
65	5:29090	*See* HEDL-SA-2015-FP
66	5:28471	*See* HEDL-SA-2009-FP
67	5:29089	*See* HEDL-SA-1966-FP
78	5:28487	*See* HEDL-SA-2055
CONF-800608-	(Air Pollution Control Association annual meeting, Montreal, Canada, Jun 1980)	
3	5:29256	Chicago, IL; Institute of Gas Technology (1980).
CONF-800609-	(10. international symposium on effects of radiation on materials, Savannah, GA, USA, 3-5 Jun 1980)	
3	5:29333	NTIS, PC A02/MF A01
6	5:29054	*See* HEDL-SA-1984-FP
8	5:29334	*See* HEDL-SA-2003-FP
9	5:30011	*See* HEDL-SA-2147-FP
CONF-800616-	(3. world hydrogen energy conference, Tokyo, Japan, 23-26 Jun 1980)	
7	5:28563	Chicago, IL; Institute of Gas Technology (1980).
CONF-800631-	(8. international cryogenic engineering conference, Genoa, Italy, 3-6 Jun 1980)	
6	5:29441	*See* LBL-10977
CONF-800634-	(International conference on nonlinear phenomena in mathematical sciences, Arlington, TX, USA, 16-20 Jun 1980)	
1	5:29858	*See* SAND-80-1235C
CONF-800638-	(Networks 80 international conference, London, UK, 3-5 Jun 1980)	
1	5:30041	*See* UCRL-83929
CONF-800640-	(14. pulse power modulator symposium, Orlando, FL, USA, 3-5 Jun 1980)	
1	5:29982	*See* SAND-80-0461C
2	5:29532	*See* SAND-80-0456C
4	5:29545	*See* LA-UR-80-1361
6	5:29533	*See* SAND-80-0460C
8	5:29534	*See* SAND-80-0491C
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12	5:29983	*See* SAND-80-0550C
14	5:29538	*See* UCRL-83970
15	5:29537	*See* UCRL-83912
16	5:29539	*See* UCRL-84013
CONF-800642-	(International gas research conference, Chicago, IL, USA, 9-12 Jun 1980)	
1	5:28305	Chicago, IL; Institute of Gas Technology (1980).
2	5:28306	Chicago, IL; Institute of Gas Technology (1980).
CONF-800643-	(14. annual conference on trace substances in environmental health, Columbia, MO, USA, 2 Jun 1980)	
1	5:29614	NTIS, PC A02/MF A01
CONF-800644-	(173. Institute of Mathematical Statistics conference, Davis, CA, USA, 16-18 Jun 1980)	
1	5:30036	NTIS, PC A03/MF A01
CONF-800647-	(International conference on the physics of MOS insulators, Raleigh, NC, USA, 18-20 Jun 1980)	
5	5:29352	*See* DOE/ER/10462-2
CONF-800649-	(International symposium on effects of air pollutants on mediterranean and temperate forest ecosystems, Riverside, CA, USA, 22-28 Jun 1980)	
1	5:29738	NTIS, PC A03/MF A01
CONF-800651-	(5. symposium on water jet cutting, Hanover, F.R. Germany, 2-4 Jun 1980)	
1	5:28881	*See* SAND-80-7031C
CONF-800652-	(DOE engineering safety conference, Las Vegas, NV, USA, 1-4 Jun 1980)	
1	5:29433	NTIS, PC A02/MF A01
CONF-800653-	(9. international congress on animal reproduction and artificial insemination, Madrid, Spain, 16-20 Jun 1980)	
1	5:29669	NTIS, PC A03/MF A01
CONF-800655-	(21. annual meeting of the Institute of Nuclear Materials Management, Palm Beach, FL, USA, 30 Jun-2 Jul 1980)	
1	5:28537	NTIS, PC A02/MF A01
2	5:28541	*See* SAND-80-0529C
19	5:28533	*See* AGNS-35900-CONF-65
20	5:28534	*See* AGNS-35900-CONF-67
21	5:28542	*See* UCRL-82248
22	5:28539	*See* K/OA-4660
26	5:28535	*See* AGNS-35900-CONF-81
28	5:29558	*See* BNL-28015
CONF-800656-	(Picosecond meeting, Falmouth, MA, USA, 18-20 Jun 1980)	
1	5:29397	*See* LA-UR-80-1619

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CONF-800659-		(Workshop on modern trends in human leukemia IV, Wilsede, F.R. Germany, 14-20 Jun 1980)
1	5:29679	*See* UCRL-84063
CONF-800660-		(Thermochemical hydrogen workshop, Tsukuba, Japan, 18-21 Jun 1980)
1	5:28561	*See* LA-UR-80-1612
CONF-800661-		(7. international conference on numerical methods in fluid dynamics, Palo Alto, CA, USA, 23-27 Jun 1980)
1	5:29271	*See* LA-UR-80-1633
2	5:29784	*See* LA-UR-80-1631
CONF-800665-		(3. international symposium on cancer therapy by hyperthermia, drugs, and radiation, Ft Collins, CO, USA, 22-26 Jun 1980)
1	5:29560	*See* LA-UR-80-1608
CONF-800669-		(American Society of Safety Engineers conference, Houston, TX, USA, 23 Jun 1980)
1	5:29972	*See* UCRL-84545
CONF-800672-		(International symposium on solar power satellites, Toulouse, France, 25-27 Jun 1980)
1	5:28583	*See* LA-UR-80-1562
CONF-800674-		(4. workshop on current problems in high energy particle theory, Bad Honnef, F.R. Germany, 2-4 Jun 1980)
1	5:29801	*See* BNL-27981
CONF-800678-		(Symposium on topical questions in QCD, Copenhagen, Denmark, 9-13 Jun 1980)
1	5:29802	*See* BNL-27995
CONF-800684-		(International conference on experimentation at LEP, Uppsala, Sweden, 16-20 Jun 1980)
1	5:29530	*See* LBL-11007
CONF-800685-		(INTOR meeting, Vienna, Austria, 16-27 Jun 1980)
1	5:29951	*See* GA-A-15924
CONF-800703-		(Annual conference on nuclear and space radiation effects, Ithaca, NY, USA, 15-18 Jul 1980)
1	5:29556	*See* SAND-80-0843C
2	5:29335	*See* SAND-80-0839C
CONF-800704-		(NATO/CCMS meeting on pilot studies, Paris, France, 15 Jul 1980)
2	5:28890	*See* LA-UR-80-1465
CONF-800706-		(Western plant engineering conference, Anaheim, CA, USA, 15-17 Jul 1980)
2	5:28578	*See* SERI/TP-733-693
CONF-800707-		(8. international conference on plasma physics and controlled nuclear fusion research, Brussels, Belgium, 1-10 Jul 1980)
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10	5:29923	*See* LA-UR-80-1828
11	5:29886	*See* LA-UR-80-1834
12	5:29922	*See* LA-UR-80-1826
13	5:29881	*See* GA-A-15899
14	5:29977	*See* KMSF-U-953
15	5:29864	*See* GA-A-15951
CONF-800709-		(Seminar on high-energy nuclear interactions and properties of dense nuclear matter, Hakone, Japan, 7-11 Jul 1980)
2	5:29814	*See* LBL-10883
CONF-800716-		(6. underground coal conversion symposium, Afton, OK, USA, 13-17 Jul 1980)
10	5:29174	*See* UCRL-84022
11	5:28302	*See* UCRL-84584
12	5:28301	*See* UCRL-84083
CONF-800719-		(International symposium of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA, USA, 28 Jul-1 Aug 1980)
6	5:28614	*See* SAND-80-1569C
CONF-800720-		(Conference of the Association for Computing Machinery, special interest group for graphics, Seattle, WA, USA, 14-18 Jul 1980)
1	5:30037	*See* LBL-10239
CONF-800723-		(19. national heat transfer conference, Orlando, FL, USA, 27-30 Jul 1980)
7	5:29082	NTIS, PC A03/MF A01
12	5:29091	*See* LA-UR-79-3301
15	5:29083	NTIS, PC A03/MF A01
16	5:29084	NTIS, PC A03/MF A01
20	5:29974	*See* BNL-27814
CONF-800724-		(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)
3	5:29787	*See* BNL-27944
5	5:29785	*See* BNL-27943
CONF-800729-		(International workshop on the analysis and interpretation of volcanic gases, Gif-sur-Yvette, France, 3-4 Jul 1980)
1	5:29590	*See* SAND-80-1173C
CONF-800730-		(27. international field emission symposium, Tokyo, Japan, 7-12 Jul 1980)
1	5:29384	*See* DOE/ER/03158-88
CONF-800731-		(Health Physics Society meeting, Seattle, WA, USA, 20-26 Jul 1980)
1	5:29721	*See* DP-MS-79-111
2	5:29723	*See* UCRL-84520
CONF-800732-		(International dynamic mass spectrometry symposium, Centerbury, UK, 7-10 Jul 1980)
1	5:28330	*See* UCRL-84366
CONF-800734-		(8. International Union of Pure and Applied Chemistry symposium on photochemistry, Seafeld, Austria, 13-19 Jul 1980)
1	5:29404	*See* BNL-28043
CONF-800737-		(Non-convective solar pond workshop, McLean, VA, USA, 30-31 Jul 1980)
1	5:28762	*See* MLM-2739(OP)
CONF-800740-		(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)
1	5:29543	*See* BNL-28019
CONF-800743-		(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)
2	5:28470	*See* GEFR-SP-215
CONF-800801-		(Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference, San Francisco, CA, USA, 4-8 Aug 1980)
3	5:29353	*See* LBL-10687
4	5:29289	*See* LBL-10808
5	5:29324	*See* BNL-27344
7	5:29288	*See* LBL-10683
CONF-800802-		(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)
4	5:28630	*See* SERI/TP-621-659
CONF-800804-		(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)
3	5:28976	NTIS, PC A03/MF A01
5	5:29477	*See* UCRL-84046
7	5:29085	NTIS, PC A03/MF A01
20	5:28813	*See* SERI/TP-351-540
CONF-800806-		(15. intersociety energy conversion engineering conference, Seattle, WA, USA, 18-22 Aug 1980)
7	5:28894	NTIS, PC A02/MF A01
15	5:29275	*See* UCRL-83824
19	5:29276	*See* UCRL-84443
25	5:29939	*See* BNL-27958
27	5:28836	*See* SERI/TP-631-567
28	5:28326	*See* LA-UR-80-1094
29	5:28809	*See* MLM-2734(OP)
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3	5:29572	*See* LA-UR-80-329
CONF-800810-		(24. SPIE international symposium, San Diego, CA, USA, 1 Aug 1980)
1	5:29468	*See* LA-UR-80-1427
CONF-800814-		(American chemical society meeting, San Francisco, CA, USA, 24-29 Aug 1980)
3	5:28415	*See* UCRL-84048
CONF-800815-		(Microprobe Analytical Society conference, San Francisco, CA, USA, Aug 1980)
1	5:28328	*See* LA-UR-80-586
CONF-800818-		(National heat transfer conference, Orlando, FL, USA, Aug 1980)
1	5:29959	*See* UCRL-83696
CONF-800820-		(American Statistical Society meeting, Houston, TX, USA, 11-14 Aug 1980)
4	5:29616	NTIS, PC A02/MF A01
CONF-800821-		(7. European electron microscopy congress and the international x-ray optics and microanalysis conference, Hague, Netherlands, 24-30 Aug 1980)
1	5:29668	*See* BNL-27917
CONF-800822-		(Oil shale: the environmental challenges conference, Vail, CO, USA, 11 Aug 1980)
1	5:28418	*See* LA-UR-80-1852
CONF-800823-		(URSI international symposium, Munich, F.R. Germany, 26-29 Aug 1980)

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1	5:29762	*See* UCRL-84281
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1	5:29786	*See* LA-UR-80-1709
2	5:29807	*See* LA-UR-80-1710
5	5:29808	*See* LA-UR-80-1733
6	5:29528	*See* LA-UR-80-1724
9	5:29774	*See* LA-UR-80-1712
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2	5:29989	*See* UCRL-83981
CONF-800920-	(Geothermal Resource Council annual meeting, Salt Lake City, UT, USA, 9-11 Sep 1980)	
11	5:28880	*See* SAND-80-1350C
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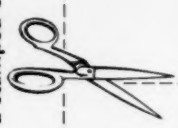

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